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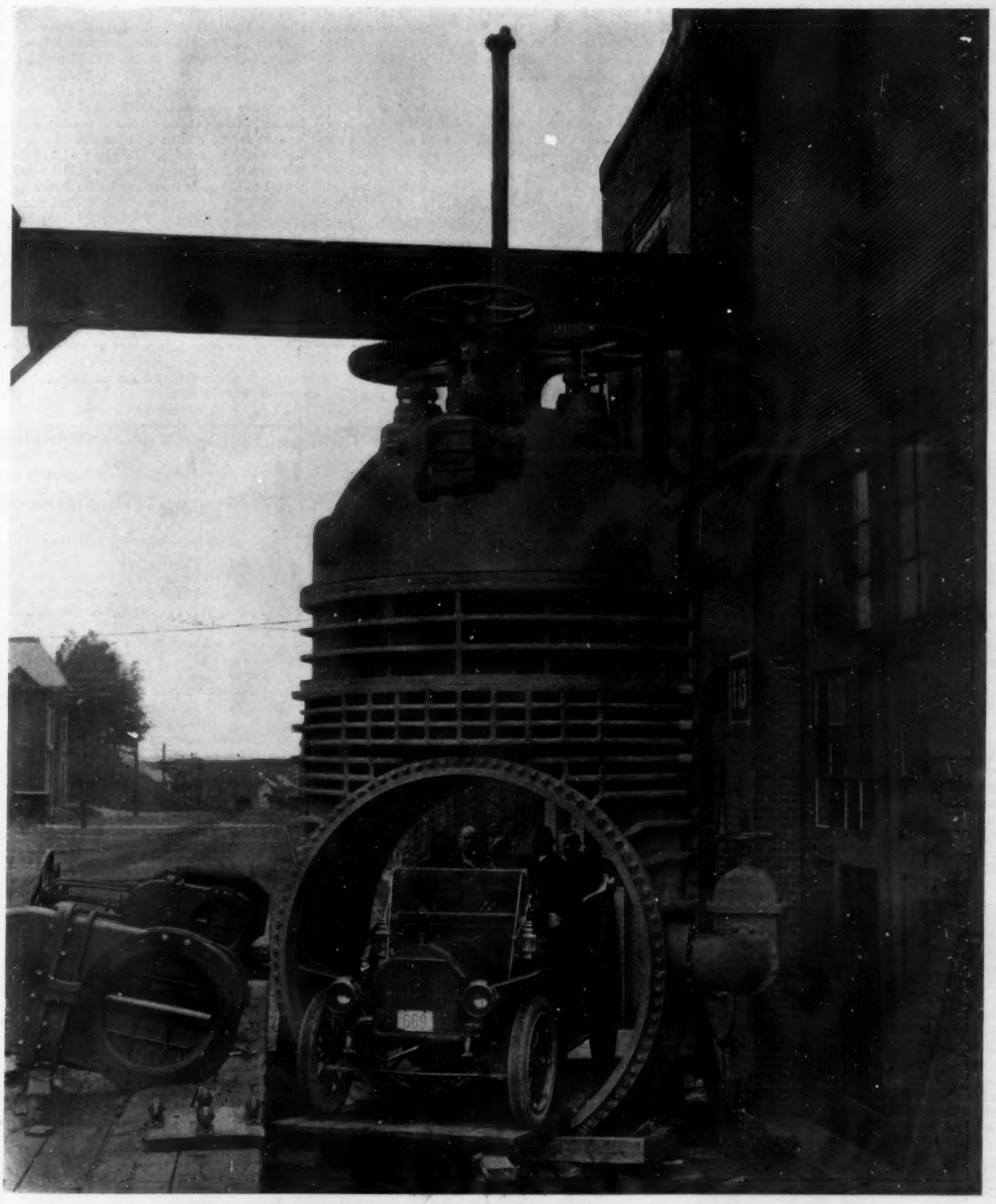

ONE OF THREE VALVES CONSTRUCTED TO CONTROL THE WATER THAT DRIVES HYDRAULIC TURBINES OF 12,000 HORSE-POWER EACH AT NIAGARA FALLS.—[See page 222.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Panama Canal Must Be Fortified

AT the Isthmus of Panama, far removed from the nearest territory of the United States, and surrounded by turbulent governments whose perpetual ferment may cause them to break into hostilities at very short notice, inaccessible except over lengthy routes by sea, there is being created at a cost of nearly four hundred million dollars, a property, the Panama Canal, whose completion, it is hoped, will greatly stimulate the oversea trade of this country and the building of an adequate deep-sea merchant marine, and at the same time greatly increase the strategic value of our navy.

It is a peculiar characteristic of this great enterprise that, in spite of the stupendous character of its works and the long years that have been needed for its construction, if it were left in an undefended condition it would be capable of quick destruction, or at least of such effective disablement as to be rendered useless for an undetermined but very considerable length of time.

Common sense and far-sighted prudence demand that, having created this invaluable property, its owners should take measures to ensure its permanence and protect it against destructive attack; and it is the unanimous opinion of both our Army and Navy Departments, that the most effectual way to protect the canal would be to construct a powerful system of forts commanding the entrances both on the Pacific and Atlantic terminals. During the past few months, much has been said and written by laymen, and by a very few military men, against the propriety of so defending the canal. Notable among the latter is a retired admiral, the value of whose professional opinion would seem to be decreasing in the exact proportion as the demand for his services as a magazine writer is on the increase. It has been urged, first, that to build defences at the canal would do violence to that policy of neutralizing the canal to which the United States is committed, inasmuch as our government would thereby assume a menacing and hostile attitude to the foreign nations that might wish to make use of it; second, that fixed defences at the entrances would not ensure the safety of the whole 50-mile length of the canal, which, at any point, would be liable to attack by land forces; third, that, since the canal has been built largely for military purposes, it is the province of the navy to defend the same by stationing its warships at either end.

It is not the province of this journal to go into the political aspects of the question, and it is sufficient to state that the right of the United States to build defensive works, if it should so desire, is clearly recognized by treaty, and that the leading naval and military experts in Europe seem to be agreed that we not only have the right, but that it is altogether expedient, to safeguard this property by suitable fortifications. Furthermore, these works would be of a purely protective and not of an actively offensive character; and, although treaty obligations might broadly be relied upon to protect the canal from hostile attack by any of the highly civilized nations of the earth, there are too many governments, possessed of fleets of no inconsiderable power, whose state of advancement in what might be called the ethical side of human civilization is not such as to make it sure that, in cases of extreme provocation, they would hesitate to seize the canal for the sake of obtaining some strong strategic position in a critical phase of hostilities.

As to the claim that permanent defences would not insure the integrity of the whole stretch of the canal, it must be borne in mind that the scheme of defence contemplates, not merely the mounting of high-powered guns at the entrance channels, but the placing of heavy garrisons for the patrol and protection of the whole stretch of the canal from shore to shore.

As to the contention that the proper way to defend the waterway is to station warships at either end, it is sufficient to state that the value of a fleet of warships lies largely in its mobility, and that the policy of tying a certain number of our ships to some particular point, and keeping them permanently stationed there, is to rob them of the greater part of their value. It was recently pointed out by Admiral Dewey that guns mounted on board ship are on a sinkable, unsteady platform; that their protection is limited; and that the range-finding devices on board a ship have a very limited range of accuracy. Guns mounted on shore, on the other hand, are placed on an unsinkable and steady platform; and being provided with widely separated range-finding apparatus of extraordinary accuracy, they are, gun for gun, of very much greater value than those mounted on board ship. If our fleet were being transferred, say from the Pacific to the Atlantic, on emerging from the Atlantic entrance, it would be at a very serious disadvantage were that entrance commanded by a hostile fleet, so drawn up that it could concentrate its fire upon each ship as it passed into the open. Conditions at the Atlantic terminus are such that, on both sides of Limon Bay, there are excellent sites for forts well advanced on outlying points. The line joining these sites is 3,000 yards in front of the point where the canal prism reaches a low-water depth sufficient for battleships. Powerful forts at these two points would suffice to keep a hostile fleet ten to twelve thousand yards distant from the canal entrance; and, under their protection, our ships could emerge and form in line of battle, before moving out to engage the enemy. Similar points of vantage are presented at the Pacific terminus of the canal by certain outlying islands that would admirably command the approaches.

"The general board," says Admiral Dewey, "considers the prime object of fortifications at the Canal Zone is to prevent its occupation by an enemy, and by their existence to enable the fleet, free from solicitude for the safety of the canal, to pursue its legitimate functions, whenever the interests of the country most demand its presence."

Oil Fuel on Ocean Liners

THE uniformly good results obtained whenever oil fuel has been given a properly-arranged test on an ocean-going steamship, have made it certain that some day, and not so very far in the future, oil will take the place of coal as the fuel of the great trans-Atlantic steamships. One remarkable fact in favor of oil fuel is that, in spite of the unusual number of advantages to be derived from the change, there is practically no serious disadvantage. Furthermore, the larger the ship, the more marked are the conveniences and economies attending the change from coal to oil.

Among the frequent studies which have been made of the problem and the many eulogistic articles which have been written in favor of oil fuel, one of the best is an editorial in a recent issue of our Scottish contemporary, *The Steamship*, which briefly summarizes the advantages of oil firing as follows: Steady steam pressure; an absence of "dirty" fires, and no necessity for cleaning fires (which last because of the opening of fire doors and cooling off of furnaces, is estimated to cause a loss of 12½ per cent of steam on a 7-day voyage, with a corresponding loss of speed); reduction of bunker space to five-eighths of that required for coal, and a great reduction of the force of stokers.

It is pointed out that portions of a ship which are now useless for coal bunkers, because of their narrowness or inaccessible position, are always available for the storage of oil fuel. The double bottom may be thus used, and the trim of the ship may be preserved by admitting sea water to the emptied oil tanks. The objectionable list to port or starboard, due to using more coal from one side of the ship than the other, is avoided; a steam pump serving to transfer oil fuel from side to side at a moment's call.

Now, in view of the many above advantages, it may be asked why the leading Atlantic steamship lines have not adopted oil fuel. The delay is due to the fact that these ships were built in the "coal age," and that, coupled with the prejudice, due largely to ignorance, of ship owners against fuel oil, there has been the financial objection to the cost of making the necessary changes in the bunkers. As a matter of fact the advantages of oil firing, if applied to the fast trans-Atlantic liners, would be so great and so quickly realized that we look for its early introduction.

Our contemporary makes a study of conditions on the "Mauretania" and "Lusitania," which shows, in a very striking way, what oil fuel could do for these great ships. The average consumption at a sea speed of 25 knots is 5,500 tons of coal for the single voyage, or 11,000 tons for the round trip. If oil were used, 3,300 tons could be stored in the double bottom of the ship, leaving the coal bunkers available for cargo. It is estimated that 600 tons of oil would do, in twenty-four hours, the work now accomplished by 1,000 tons of coal; and this would represent a saving of about 2,000 tons of fuel on the five-day single voyage, or of 4,000 tons on the round trip. If the vacant bunker space, or its equivalent, in a ship of similar size and speed, were utilized for freight at $5.00 per ton, the earning capacity of the ship would be greatly increased. Of the 312 firemen and coal trimmers now carried on the Mauretania, 285 could be sent ashore and used in handling the extra cargo that would be carried. In place of 312 firemen, it is estimated that 27 greasers would be sufficient to attend to the oil burners and to the water feed of the boilers. By alterations of the accommodations now reserved for the 285 firemen and trimmers, it is estimated that at least 200 third-class passengers additional could be carried at $25 per passenger. An estimate of the total economies shows that the increased earning capacity of the "Mauretania" on a round voyage from Liverpool to New York and back, would be about $60,000.

Lastly, on the important question of speed, it is argued that since 32 fires out of 192 furnaces in the boiler rooms of the "Mauretania" are cleaned every four hours, some 10,000 out of 70,000 horse-power must be lost through that disturbance of the fires and the cooling off of the furnaces which is inseparable from cleaning—all of which is avoided under oil firing. Our contemporary believes that the use of oil fuel alone would reduce the time of the voyage between Queenstown and New York by from eight to ten hours. If so, the "Mauretania" might be able to make the voyage in an even four days.

The Self-igniting Oil Engine

COMMENTING upon the advantages of the Diesel motor in one of our last month's issues, we pointed to the apparent neglect which this engine has suffered in our States. We have since received several communications, in which it is urged that the Diesel system has not been wanting in appreciation, and that the motors have been regularly manufactured and put upon the market under a series of patents controlled by a leading St. Louis capitalist, with such effect that the aggregate horse-power in use at the present day has reached quite a considerable figure.

In point of fact a manufacturing company of Cudahy, Wisconsin, has in the past been building Diesel motors for the St. Louis interests, and in the future their construction is to be carried on in a special plant now in project at St. Louis. The Diesel motor has, therefore, not failed altogether to find supporters here. Indeed, some notable improvements in its design are distinctly American introductions, such for instance as the use of a long piston in place of the original cross-head, and a skillful modification of the air-compressor, which has greatly simplified the Diesel installation. Nevertheless, it does not appear that the spread of the Diesel has been at all proportionate to its virtues. Its manufacture requires special care and attention in the choice of material and in workmanship. While the pains thus bestowed upon the work of production are amply repaid by the great advantages gained, the first cost of the Diesel engine is necessarily somewhat higher than that of a corresponding steam unit of the more common types. The immediate gain derived from the substitution of the Diesel in place of steam power depends, of course, in considerable measure on the relative costs of coal and oil. It is largely for this reason that its adoption in Europe, in localities where the price of coal is comparatively high, has progressed with more rapid strides than here. But even under the most favorable conditions, the advantage seems to be on the side of the Diesel; and although, as has been pointed out, the aggregate horse-power of the system in this country has risen to a very appreciable figure, the Diesel motor cannot be said to have received its proper share of attention.

Silvanus Philipps Thompson, F.R.S.

The Noted Electrical Engineer and Physicist

By P. F. Mottelay

THE usual series of Christmas lectures at the Royal Institution of Great Britain has this year been delivered by Prof. S. P. Thompson, whose extended scientific investigations and discoveries have earned him a world-wide reputation. The subject which he has chosen for this year's lectures is that of "Sound, Musical and Non-Musical."

Prof. Thompson, of whom the accompanying original photograph was especially taken last month for this publication, is a native of York, where he was born, of Quaker parentage, June 19th, 1851. In 1881 he married Jane, eldest daughter of the late James Henderson, of Pollokshields, a lady of considerable musical and literary ability, who has in late years contributed many highly creditable articles to magazines mainly in the form of translations from the Italian and the German.

Silvanus Thompson was educated at the famous Friends' school in York, which he left in order to attend the Flounder's Institute, Pontefract; afterward he followed courses at the Royal School of Mines, and continued his studies at the University of Heidelberg. His extraordinary proficiency in learning and his indefatigable researches won him many notable distinctions at the very outset of his career, and the progress which he has made since he entered the field of electrical engineering, in which he has so markedly distinguished himself, is a record to be envied by many, but reached by only a few. He received from London University the degree of B.A. in 1869, B.Sc. in 1875, and D.Sc. three years later, and he has since been made an LL.D. at Birmingham, as well as an honorary M.D. of Koenigsberg. He is a fellow of the Royal Society, of the Royal Astronomical Society, and of other learned bodies, also member of the Royal Institution of Great Britain, of the Royal Academy of Sciences of Stockholm, and of the American Philosophical Society, and has been senator as well as examiner of London University, in the organization of which latter he took a very prominent part.

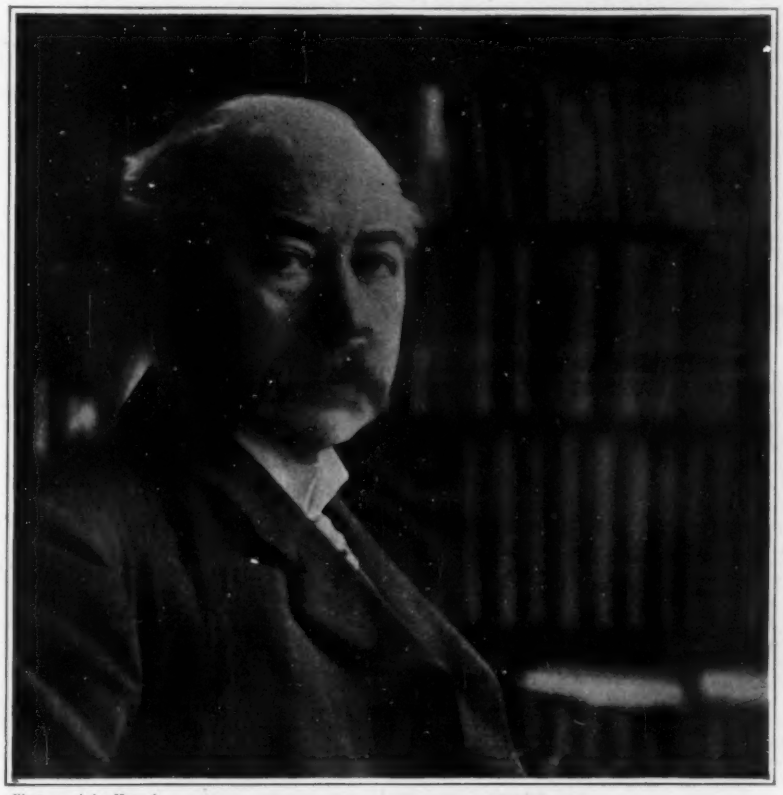
The extraordinary command of languages possessed by Prof. Thompson enabled him to personally deliver two admirable foreign lectures —one in Italian on "Magnetic Images and Their Application in the Theory of the Rotatory Field Motor," before the Volta Centenary Congress at Como, which he attended as a delegate in 1899, and the other in German on "Michael Faraday," before the Urania Society of Berlin, during January, 1901. In the month of June of the same year he delivered, at Oxford, the Boyle lecture on "Magnetism in Growth." Among his numerous other important papers should be singled out those forming the subject of the Cantor Lectures of 1883, 1890, and 1895. The first, it has been truly said, established his reputation of being a leader in the special study of the construction, theory and mode of working of electro-dynamic machinery. The second, in 1890, was on the electro-magnet, a subject to the study of which he had given much of the previous seven years, while the third, in 1895, was entirely devoted to the arc light. Other lectures worthy of particular notice are those of 1887 and 1888 before the Institution of Electrical Engineers, one on his telephonic investigations, and the other on the influence machine; of 1898, on rotatory converters; of 1905, before the Society of Arts, on high speed electric machinery, with special reference to steam turbines, dynamos and alternators, and the first Kelvin lecture delivered at the Institution of Electrical Engineers during 1908. He has contributed many papers to the leading scientific publications, among the most important of these being a communication to the Physical Society, "On Physical Optics and on Geometrical Optics," and another to the Society of Arts, "On the Mercurial Air Pump."

He is the author of numerous valued works which have placed him foremost in the fields of both pure and applied science. He began in 1884 the publication of his treatise on "Dynamo-Electric Machinery," which is now in its eighth edition, and which has been translated into French and German. He published his book on "The Electro Magnet" (a greatly enlarged reprint of the 1890 Cantor lectures), of which there were French, German, and Russian editions. He rewrote and considerably enlarged his "Elementary Lessons in Electricity and Magnetism," which had run into 40,000 copies in eight years, and which appeared in French, German, Italian and Polish. In 1896 he issued the first edition of "Polyphase Electric Currents and Motors" (second edition, 1899), which was translated into French and German, and during 1897 published a volume on "Light Visible and Invisible." He further wrote "The Life of Philip Reis," who invented a telephone, 1860-1863 (1883), "Michael Farady—His Life and Work" (1893), and he is at present reaping the benefits of the three years he devoted to the preparation of "The Life of Lord Kelvin," which has just been issued through London publishers in two large attractive octavo volumes.

Dr. Thompson was one of the founders of the Gilbert Club, organized for the express purpose of rendering into English a work published in 1600 under the title *De Magnete*. He took a very prominent part in the translation, and published an admirable and very valuable series of notes thereon, following them up with numerous lectures on the life and work of the first electrician. To the above he added a translation of the 1269 *Epistola* of Petrus Peregrinus, which he had printed by the great Chiswick Press in right royal form for private distribution. In the preparation of the notes, the lectures and numerous articles on these early writers that followed, Prof. Thompson was very fortunate in commanding the resources of his profuse private library of electrical literature. His collection of early editions, known to the writer of the present article, is, without question, the largest in existence, far surpassing the Ronalds and the Latimer Clark libraries, not only in number and in separate issues, but in the excellence of the bindings.

The singular versatility of Dr. Thompson is evidenced by his admirable water colors of Alpine mountain glaciers and of Canadian scenery, as well as his sketches in black and white, his card illuminations, his etchings of portraits, among which is one which he prepared with his own hand for his work on Michael Faraday, and his rubrications of the 1269 Petrus Peregrinus translation.

The accompanying photograph is an excellent likeness of Professor Silvanus P. Thompson as he appears at the present day. As he stands before us, we find him to be a man of average height and of good build, well groomed, hale and hearty. His head, well poised upon strong shoulders, is tinged with gray. The brow is wide and the eyes are clear and well set, denoting quick, intelligent perception. In manner, he is alert, very genial, frank and open. His voice is sympathetic and very clear, while his enunciation is remarkably distinct. The general impression of his personality is very attractive. To this fact and to the peculiarly comprehensive manner in which his teachings are presented, may be attributed the wide popularity he enjoys among his students, as, indeed, he is highly esteemed by all those who have listened to any of the numerous addresses to which we have already made allusion. A great deal has been said, and deservedly, in praise of the careful, methodical preparation of his lectures, evidencing as they do laborious bibliographical and statistical and experimental research. He is very patient, painstaking, anxious to develop the bent of his many students, and it has been truly said that, as a teacher and trainer of young men, more especially in electrical engineering, he is believed to have no superior throughout Great Britain.



Photograph by Hoppé.

PROF. SILVANUS PHILIPPS THOMPSON

The Southernmost Meteorological Station of the World

THE Bulletin of the Mount Weather Observatory publishes a report from Vice Consul-General C. L. Chandler, stationed at Buenos Aires, on the meteorological station of the Argentine government at Amond House, Laurie Island (Scotia Bay), in the South Orkney group of islands—the southernmost permanently inhabited spot in the entire world, situated in 60 deg. 40 min. south latitude, and 44 deg. 39 min. west longitude. The station was established by the Scottish Antarctic Expedition, headed by Dr. W. S. Bruce, on the 25th of March, 1903, and was taken over by the Argentine government on the 21st of February, 1904, since which date it has been administered by the Argentine Ministry of Agriculture, which maintains a staff of four men—three observers and a cook—at this isolated place, the nearest inhabited place to the south pole.

Although the South Orkneys were discovered by Powell in 1821, and visited by Weddell in 1823, Dumont d'Urville in 1838, and Larsen in 1893, they remained practically unknown until the return of Dr. Bruce's Antarctic expedition in 1904. The chief islands are Laurie and Coronation. Communication between the South Orkneys and the outer world is maintained by an Argentine naval vessel, which, leaving Buenos Aires in January to relieve the staff at that lonely outpost, arrives there after a three weeks' voyage, in February, and after a short stay returns to Buenos Aires, arriving there in March. Stops are sometimes made at points of interest *en route*.

The Argentine meteorological service has also maintained, since 1906, a station at South Georgia island, and stations are contemplated on one of the Sandwich group, from which Filchner expects to make his advance into Weddell Sea next year, and at Wandel Island, in 65 deg. 4 min. south latitude, where the French expedition under Charcot wintered in 1904-5.

It is hoped that the results obtained by these stations will be of practical as well as scientific utility, in increasing our knowledge of the winds and storms around Cape Horn, and indicating the safest routes for mariners in that dangerous region.

The Physiology of Marching

THE reputation of Germany as a country where life is regulated as much as possible in accordance with the principles of science is borne out by the regulations of the German military authorities concerning the marching and physical training of troops. The "physiology of marching" has been the subject of careful investigation, and the results obtained are taken advantage of for the benefit of the German army. Among the conclusions reached is that during continuous heavy marching the rations supplied are not sufficient to replace waste of carbohydrates, and that a day's rest is required after every three days' marching, to enable the body to recover its normal power.

Velocity of Meteors

AN amateur astronomer has devised a simple and ingenious method of measuring the velocity of meteors, or "shooting stars." He photographs the meteor through a wheel with alternate opaque and transparent sectors, which is mounted in front of the camera and turned by an electric motor, at a rate of from 30 to 50 revolutions per minute. The velocity of the meteor at right angles to the line of sight can be calculated from the interrupted line which it traces on the photographic plate, when the speed of the wheel and the width of the sectors are known. This method takes no account of the obliquity of the meteor's paths and consequently gives merely its transverse, not its actual velocity.

An Automobile Water Tower

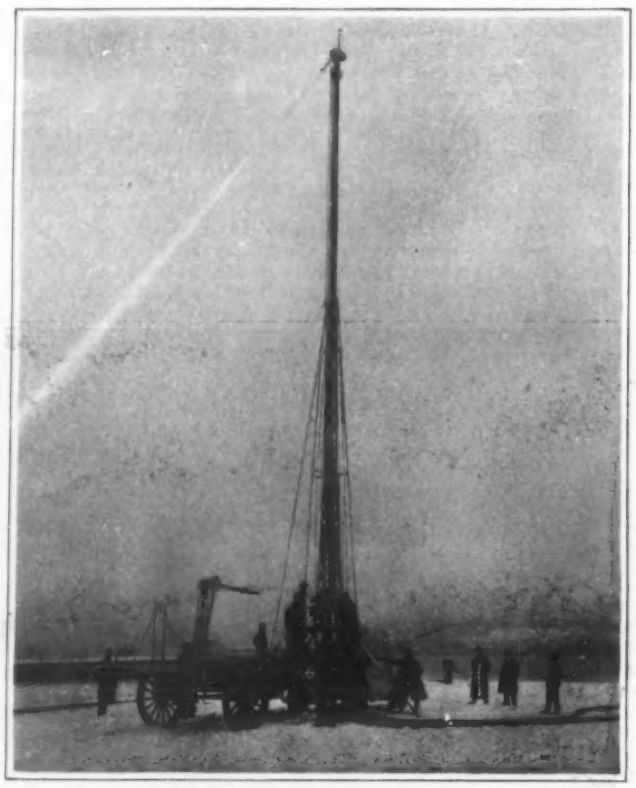
New York's Novel Fire Apparatus

By Herbert T. Wade

ONE of the most useful pieces of apparatus for the fire department of a large city is the water tower, by means of which a powerful stream of water can be directed into a burning building with striking effect, especially up to a height of 100 feet. An overall length of about 45 feet and a weight of about seven tons, however, make the water tower rather unwieldy as portable apparatus, and at best it furnishes a good draught for three strong horses, while under conditions of snow and ice it can be drawn often only with the greatest difficulty and so slowly that valuable time may be lost in reaching the fire where its services are in demand. Accordingly when motor apparatus was beginning to be introduced into fire departments, keen witted officials and practical firemen saw how greatly a suitable automobile running gear for the heavy water tower was needed, but the long wheel base furnished a difficult proposition for automobile engineers. This has been realized now in a machine undergoing a thorough and practical test at the hands of the New York Fire Department, which from preliminary results seems to meet the situation completely. The water tower, it will be recalled, so far as length and general arrangement are concerned, somewhat resembles in appearance the extension ladder truck. It consists of a stand pipe so mounted that from a normal horizontal position collapsed for transport it can be raised to stand vertically, and then an extension pipe surmounted with a nozzle can be elevated still farther to a height of 65 feet. This nozzle is capable of direction from the deck of the truck and several hose lines may be siamesed to feed the stand pipe so that a powerful stream can be delivered. Fed from high pressure hydrants or from several fire engines, the water tower is indeed a useful weapon in the hands of the firemen, and in the downtown business districts of New York it goes out on the first alarm with the other apparatus.

In order to test motor propulsion for this purpose an ordinary water tower, in fact the reserve one of the New York department, was taken and the front wheels and other running gear of the forward part of the truck along with the poles were removed and in their place was substituted a chassis with powerful engines, thus making a six-wheeled piece of apparatus, but much shorter and easier controlled than when horse drawn, taking into consideration the horses. No other changes were necessary than to supply the chassis, and the added weight gave increased stability to the tower when in service at a fire, especially as the water tower frame can be firmly locked to the frame of the chassis. This is a very important consideration when it is recalled that water at a pressure of 165 pounds may be delivered from the nozzle. But to find a suitable motor for this work was important, as in addition to the long wheel base greater power was required than as yet had been applied to automobile fire apparatus. For this work absolute reliability is essential, together wtih power, speed, ease of operation, and control and adaptability, and these must be insisted upon by all fire departments, especially those as conservative as that of the city of New York, where in view of the immense interests safeguarded no chance can be taken in the failure of the mechanical equipment.

Accordingly for one of the water towers the manufacturers of a semi-trailer motor truck chassis that had been used successfully on coal carts and other heavy commercial wagons and vans, placed at the disposal of Fire Commissioner Waldo for trial at their own risk a driving mechanism that under other conditions of service had made a good record for power and reliability. This was a short heavy chassis with four-wheel drive and four-wheel steer designed on the couple-gear principle and constructed by the Couple-Gear Company of New York city. This chassis is placed under the front end of the wheels, whose fifth wheel is pivoted on a universally jointed platform attached to the chassis. There is a four-cylinder gasoline engine of 50 horse-power capacity direct-connected to an electric generator, from which current is supplied to four motors, one inclosed in each of the steel disk wheels of the chassis. The axle carries the motor and field magnet, which are stationary, while there is a rotary armature at each extremity of whose shaft are small gear wheels which mesh into large gears on the inner faces of the wheel disks close to the rims of the wheels. Consequently the power is applied at each of the four wheels, mounted as it is on an individual steering pivot, and this distribution makes control of speed and steering very effective, both front and rear wheels being united into a single steering mechanism. Each motor is rated at three horse-power, but they are capable of standing considerable overload, and thus exerting considerable pulling power. They are entirely inclosed, water proof and dust proof, and the flexible conductors are only required on account of the motion of the axles in steering. There is a foot throttle regulating the speed of the engine and the current output, and a foot lever applying powerful band brakes to all four wheels. Steering is accomplished by a large hand wheel, while at the driver's left there is an electric controller to facilitate regulation in hill climbing or under other unusual conditions of roadway, as per example when it is desired to double the pulling power by diminishing the speed one half. The entire chassis can be turned at right angles to the frame, and steering and speed regulation are easily accomplished. Thus when the throttle is at the closed position, the engine turns over fast enough to keep it going, but not fast enough to deliver any considerable current. Pushing the throttle open sends as much current as is needed for the motors, and instantly the machine is under way. The machine can be backed and maneuvered at the fire with a facility hitherto impossible, while it can be turned without being drawn around the block. This increased facility of operation commended itself at once to the firemen using the new motor.

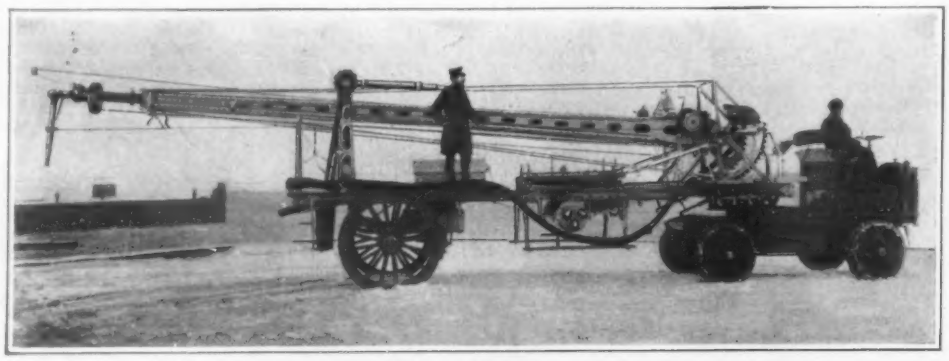


The automobile water tower in action.

Hardly had the new machine been tested at the repair shops of the fire department, as here shown, and on the pavements where a speed record in excess of 12 miles an hour was made, or double that of the three-horse team, when it was put into active service to try it out. Within 48 hours the water tower thus equipped answered three alarms and served at one serious fire. In fact one of these responses was made while the new machine was being examined by the writer in behalf of the SCIENTIFIC AMERICAN, and he was able to witness the starting of the engine and the passage through the streets to answer an alarm to a station at which it was due. The engine was started, chauffeur and firemen were in their places, the throttle opened, and the heavy tower rolled out on the pavement before the horses of the large high pressure hose wagon on the adjoining floor had passed the open doors. Over the pavement it was driven so rapidly that it reached the fire practically simultaneously with the lighter horse-drawn apparatus.

This fire, though of slight importance, was typical of the new order in fire practice. Not an engine answered the alarm, for when water tower, hose wagons, and hook and ladder trucks had reached the scene, the high pressure pumps at the distant station had been started, and it was only necessary to stretch hose lines from the hydrants to which they had been attached. A year from this time there will be even a greater change in the picture, for the high pressure apparatus will be for the most part motor-driven, the water tower equipment just described doubtless will have been formally accepted, one or more extension ladder trucks will be similarly equipped, and the battalion chiefs will have been supplied with motor cars. There is also made possible the use of a still higher and heavier water tower which might be used with advantage under many conditions, but which hitherto has not been possible, for the limit of size of all portable fire apparatus previously has been set by the draught that can be handled by three horses.

Such innovations as the new motor apparatus are all in the interest of efficiency and economy, and are not the rash adoption of novelties. Commissioner Waldo is to be congratulated on the steps he is taking to put the New York Fire Department on a motor basis, and thus keep it in the forefront of progress and efficiency. These innovations are of great importance, and are meeting with the enthusiastic approval of firemen of all ranks. The elimination of the horses makes the quarters more comfortable and sanitary, the increased speed in reaching a fire makes the work in extinguishing it lighter, while the addition of new mechanical apparatus to be studied and its use mastered tends to raise the engineering and practical standards which no less than the old-time heroism are demanded of the modern firemen. And finally the taxpayer is interested in the fact that the new motor apparatus greatly cuts down the cost of maintenance and gives increased fire protection to the community.



New York's new automobile water tower. On a snowy day it made a speed of 15 miles an hour.

A NOVELTY IN FIRE APPARATUS

The Freezing Point of Oranges

A SERIES of important and interesting experiments has just been carried out in the laboratory of Rollins College, Winter Park, Fla., by Dr. O. W. Sadler, Jr., for the purpose of determining the freezing points of the juices of different varieties of oranges. The juices of the ordinary orange, tangerine, grapefruit and tardiff (Valencia) were tested for this purpose.

In preparing for the test, several pieces of each variety from oranges from different trees were selected, and three samples from each piece were used for the test. The juice of each sample was strained and cooled, and with the thermometer immersed in it, was watched closely as the mercury went down, readings of the instrument being taken every few seconds, and at the moment freezing began, the temperature was carefully recorded. The following are the averages of the repeated tests:

Freezing point of the juice of the ordinary orange, 21.79 deg. F. Freezing point of the juice of the tangerine, 22.57 deg. F. Freezing point of the juice of the grapefruit, 22.16 deg. F. Freezing point of the juice of the tardiff, 21.87 deg. F.

The temperature of the freezing varied in the different samples of the same variety, the range being 19.40 deg. to 22.44 deg. F.

The thermometer used was a high-grade instrument that had been compared with the Rollins College standard thermometer, one of Henry J. Green's best instruments.

The Bleriot "Bus"

A Record Passenger-carrying Trip of a New Monoplane

BLERIOT, the dean of the French airmen, has added distinction to his already distinguished name by building an aeroplane of entirely novel construction, in which he has surpassed all passenger-carrying records for an aeroplane, by flying, with eight people aboard, around his aerodrome at Pau, France.

The new machine was designed specially for passenger carrying, and at the time our photographs were taken, it was provided with four permanent passenger seats, one pair being just in front of the trussed framing of the main plane, and the second pair in front of the vertical posts carrying the forward end of the engine frame. The side view of the machine shows another seat midway between the main surfaces and the tail. This last, however, was probably a temporary seat that may have been used during the maximum passenger-carrying test.

To those who are acquainted with the standard Blériot machine, it will be evident at the first glance how wide a departure has been made from that pattern. As was to be expected, the size and weight have been greatly increased. The main surface has a spread of 42.64 feet, and a general width of 10 feet, the exact total area being 430.5 square feet. A 100-horsepower, 14-cylinder Gnome engine is used, and the total weight of the machine, empty, is 1,322.7 pounds. The pilot and seven passengers, gasoline, lubricating oil, etc., weighed on the trip above referred to, 1,102.3 pounds, making the total weight of the machine, with its human freight, etc., 2,425 pounds. It will be seen that the total load carried per square foot of lifting surface was 5.63 pounds.

In this connection, it is interesting to note that Farman has built a baby biplane, with 150.7 square feet of sustaining surface, which is supposed to carry 6.14 pounds per square foot, while the same French authority states that a Hanriot monoplane has been designed to carry a load of 7.68 pounds per square foot. Blériot himself expects to be able to carry ten people, including the pilot, in which case his big monoplane will have to support over six pounds per square foot of surface.

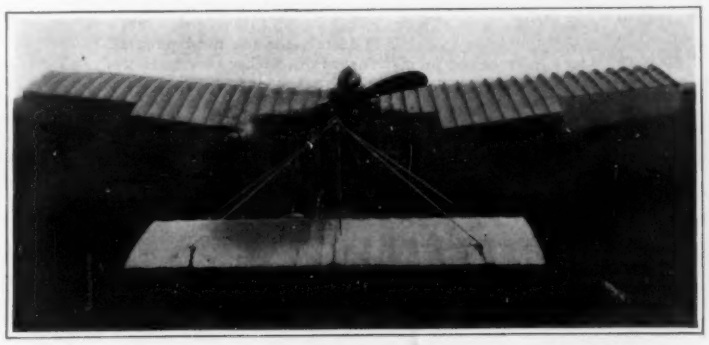
Outside of the main longitudinal frame of the machine, and the system of cushioning the forward wheels, there is nothing in the constructional arrangement of this big monoplane to remind one of the standard Blériot type. The main surfaces are built with the dihedral angle, this for purposes of automatic stability. Warping has been abandoned in favor of the hinged flaps, which are used in the Farman and other types. The motor is still carried at about the old level with regard to the main surface, but it has been removed from the front to the rear: and the gasoline tank, which formerly was hung below the pilot's seat, is now elevated above the engine. The longitudinal frame and the seats for the pilot and passengers are carried at a depth of six or seven feet below the main surface.

The most radical change of all, however, is the substitution of the front in place of the rear elevating plane. The tail consists now of a large curved rigid surface, measuring about 6 by 15 feet, with a single vertical rudder carried above it, the rudder posts and the tail piece being stayed by rigid tubular struts.

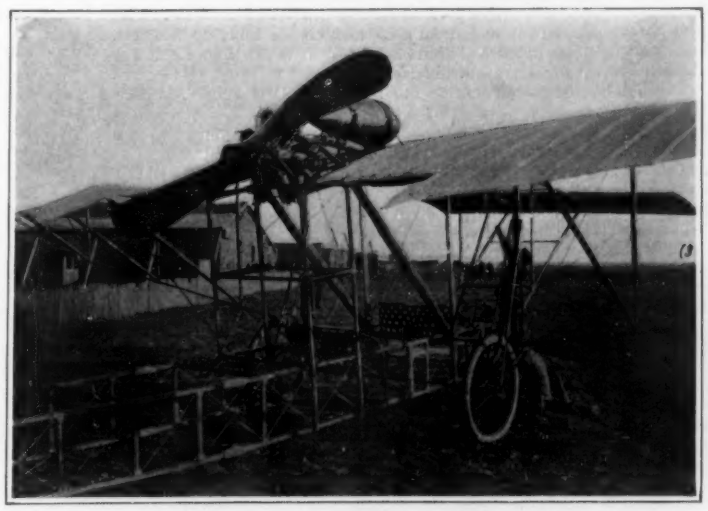
Blériot, in all his experimental work, has possessed the inestimable advantage of a thorough technical training, being a graduate of one of the leading institutes of France; and his skill is shown in the system of trussing which he has adopted for holding his main surface and heavy and powerful motor in their proper relation to the rest of the machine. The main surface is built up of a series of deep, strong ribs, with a single covering of fabric laid on their lower surface. Its front is carried upon the top chord of a deep and rigid truss, which extends for its full length, and at each panel point of this truss is formed a rigid triangle, arranged in a longitudinal vertical plane, the top member of which extends from front to rear of the main surface, with the diagonal member reaching from the rear edge of the main surface down to the bottom chord of the main truss. The heavy 100-horse-power Gnome engine is supported on a rectangular frame, which extends from the longitudinal frame up to the main surface, and the forward thrust of the propeller is taken by two stout inclined diagonal struts, as clearly shown in the photograph. In the picture showing the eight people that made the record flight, the pilot, Le Martin, is shown in his seat with his left hand upon the wheel for controlling the elevating and vertical rudders and the flaps or ailerons, and his right hand near the spark and throttle control. It will be noticed that the rocking shaft and wheel, with its bell-shaped base, is retained in this machine, as are also the spring buffers for cushioning the running wheels in starting or landing.

Altogether, this must be considered as one of the most interesting aeroplanes that has been brought out for many months past. In its intitial test, on February 2nd, Le Martin carried his wife and six other passengers and circled the Blériot aerodrome at Pau for eight minutes. The fact that Blériot expects to carry as many as eleven people in the near future shows that this first aeroplane omnibus has sufficient fuel capacity to keep in the air for a considerable time.

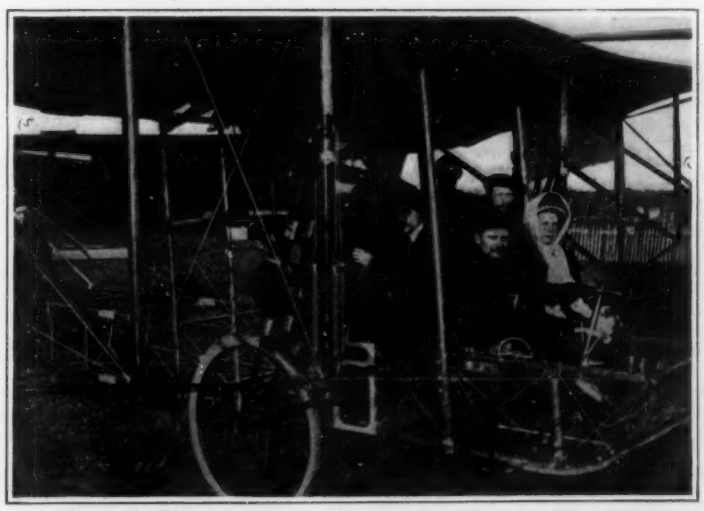
Side view of the Bleriot "Bus" which recently carried eight people. Sustaining surface, 430.5 square feet. Weight with passengers, 2,425 pounds.



Rear view of the new passenger-carrying Bleriot monoplane. Note the dihedral angle of the main plane.



The 100-horse-power Gnome engine, now placed at the rear of the main plane.



The eight people aboard the monoplane ready for the trial flight.

THE BLERIOT MONOPLANE "BUS"

Capt. Bellenger's Flight from Paris to Bordeaux and Pau

THE particulars which have just been received regarding Captain Bellenger's wonderful cross-country flight from Paris to Bordeaux (323 miles) in 8 hours 28 minutes, including two stops, show that the actual time in flight was but 5 hours 21 minutes, so that the average speed was 60.35 miles an hour instead of over 40, as previously stated in these columns. Starting from Vincennes on his Blériot monoplane at 8.35 A. M. February 1st, Capt. Bellenger steered toward Etampes. He kept to the west of Orleans and passed over Blois, finally landing at Pont Levoy at 10.32 for rest and replenishment of fuel and oil. Resuming his flight at 12.22 P. M., he flew to Poitiers, where he stopped for lunch at 1.28. Despite the cold, the captain began the last stage of his journey at 2.45, and following a straight course, he reached Bordeaux at 5.03. The total time in flight was 5 hours 21 minutes, which corresponds to an average speed of 60.35 miles an hour. The officer found the wind very troublesome toward the end of his journey, especially in the vicinity of Angoulême. As the weather was unfavorable the next morning, he did not start until 2.50 P. M. The 105 miles to Pau were covered in 1:55 without mishap, making a grand total of 428½ miles covered in 7 hours 5 minutes actual flying time in the course of two days. Capt. Bellenger remained at Pau for some days and took trips in his Blériot to different points of interest he desired to visit. He is the second aviator to fly from Paris to Bordeaux, the first to accomplish this being M. Bielovucie last summer in his Farman biplane. Bielovucie's time in flight was 7 hours and 5 minutes, or about 1¾ hours longer than Capt. Bellenger's.

The fastest time ever made by road between Paris and Bordeaux was accomplished by Gabriel in the Paris-Madrid automobile race. Gabriel's time was 5 hours and 13 minutes. The Sud express covers the distance in 6 hours and 43 minutes, while Huret pedaled it on a bicycle in 16¾ hours, Anatole rode it on horseback in 50 1/3 hours, and Peguet walked it in 114 hours and 42 minutes.

Some idea of the distance traversed can be had by noting the places Capt. Bellenger could have reached had he traveled in other directions. Had he flown toward England he could have reached Plymouth, Cardiff, or Birmingham; or if toward Germany, Münster, Frankfort, or Stuttgart. Zurich could have been reached in Switzerland, Grenoble in the southeast of France, or Brest in the west.

At the same time that Capt. Bellenger was making his great flight, Lieut. Menard, in response to a telegram from the Minister of War, left Chalons camp with Capt. Camine as passenger and headed for Satory, near Versailles, and about 125 miles away. The start was made at 9.30 A. M., and although the temperature was several degrees below freezing, the lieutenant sent his Farman biplane to a height of 3,000 feet and only once or twice on the journey descended to half this altitude. A safe landing was made at Satory 2 hours and 5 minutes later, the flight having been accomplished at an average speed of just over 60 miles an hour.

On January 30th, while passing one of the four tests required in order to obtain their military aviator's certificate, Lieuts. Conneau, De Rose, Malherbe, and Tricornot flew 62 miles across country from Pau to Puydo on their Blériot monoplanes. They turned at a height of 2,000 feet, and three of them returned without mishap. Conneau's fuel gave out at Orthey, and in a forced descent he damaged his propeller and chassis. He was able to complete the return journey the next day, however.

Observations Among the Workshops of Europe—II

Practical Hints for the Extension of Our Machinery Trade

By Capt. G. L. Carden, U. S. Revenue Cutter Service

(Concluded from SCIENTIFIC AMERICAN, February 25th, 1911, Page 198.)

[The value of the European market as an outlet for American trade has increased rapidly during the past few years. With a view to ascertaining conditions in the machinery trade, the United States government recently sent Capt. Carden to Europe, where he was given unusual facilities for inspecting the establishments, big and little, which are engaged in the manufacture of machinery. Capt. Carden finds that there are great opportunities open to American trade, particularly in the export of those machine tools in which we lead the world. The following articles will be found to contain much valuable information as to the conditions prevailing in Great Britain and on the Continent.—EDITOR.]

IN general terms, the cheapest work in Europe is to be secured in Belgium. This is a thickly populated country in which labor is plentiful. The entire tendency in Belgium is to industrial labor-saving machinery wherever possible. The Mélotte works of Remicourt, Belgium, are an instance of recent Belgian practice. M. Mélotte visited the United States at the time of the St. Louis Exposition and upon his return equipped his works with the most up-to-date American automatic machine tools. The Mélotte works are engaged in the manufacture of cream separators. This calls for most exact work and is largely of the series character. Remicourt possesses one of the finest installations of machine tools to be found on the Continent of Europe, and practically all the workmen in the Remicourt plant are recruited from young men of the neighborhood, the majority of whom have had little or no previous shop experience.

In Liége, Belgium, it is possible to purchase firearms probably cheaper than anywhere else in the world. Most of the work on these Belgian firearms is performed in the homes of the workmen. It is no uncommon sight to see boys, and even girls, on the streets of Liége carrying bundles of firearm mechanism to be worked up at their homes. A Belgian workman on returning from his day labors will often work for two or three hours at night on some of this firearm material.

Notwithstanding the low wages paid, the new Pieper Works, near Liége, which undertake exclusively the manufacture of firearms, are being equipped with some of the best automatic American machine tools.

At the Pieper Works rifling machines of Pratt & Whitney, Hartford, Conn., make were being operated by women. One woman was able to superintend three machines. In one Continental arsenal, rifling work was being performed by Belgian machines with one workman assigned to each tool. The American machines at Pieper's were turning out three times as much work in the same time as the Belgian rifling machines. Belgian territory offers to-day especial opportunities for not only American machine tools but American machinery in general.

The history of machine tool works in Russia has been, for the most part, one of failure. Numerous instances can be cited of works established, both with Russian and foreign capital; but in most cases they have either not succeeded or have had indifferent success. Well-known opinion inclines to the belief that these failures have largely been due to the methods followed in manufacture. The Russian workman is doubtless capable of as good work as men of any nation on the Continent of Europe; in several essentials he is better than the men of some countries, for the Russian will stick to a tool and become thoroughly expert in its handling. Wages are not high, and practically all material necessary for machinery building is obtainable within the country.

At the Singer works at Podolsk and at the Pneumatic Tool Works in St. Petersburg, both of which firms are under the management of Americans, there is evinced a high order of efficiency. In both plants Russian machines are working to the same standards and gages as in American shops. The speed of the Russian shops may not be equal to that of the best American plants, but it approximates very closely to the speed of the average American works.

The Semenoff Works of St. Petersburg contain many high-grade American machine tools of medium sizes. This plant is engaged in the manufacture of machine tools and cigarette and cigarette tube-making machinery. At the Semenoff shops the workmen are supplied with complete drawings of all parts, and the manufacturing methods followed are patterned largely after those in vogue in the best American plants. Here I found that the chief of the drafting department had introduced a principle of separate drawings for each piece, standard drawing sizes, and standard parts in machinery designed, with a classification of drawings based on the Dewey decimal classification.

It is not common to find jigs in very much use in European shops; this is largely because of diversified manufacture and also because European builders will undertake to build to special requirements of the purchaser. At the Semenoff shops, however, jigs are used extensively. Here I found that the Crucible Steel Company of the United States is supplying material for the manufacture of cigarette-making machines. This crucible steel, which is declared to be better than German steel because of its softness, is employed for all parts under one and a half inches in size.

Russia to-day is able to secure, for the most part, all material required for machinery work in her own territory.

In the two countries of Denmark and Holland there is a marked disadvantage under which the machinery builders labor. Denmark, for example, is devoid of ore and coal. The same statement applies to Scandinavia in general. There is some coal in Sweden, but it is reserved largely for the use of the warships. Practically all material for machinery work in Denmark is imported from Germany. This means that the Danes must of necessity work to very close production margins in their shops, and they are naturally keen to secure any shop equipment which will lower this initial cost. The principal manufacturing works of Denmark are located in and about Copenhagen. A notable exception is the Scandia Works, located in Randers (Jylland). This plant is engaged largely in the manufacture of tramway cars and railway equipment. The most important single manufacturing concern in Denmark is Burmeister & Wain. This firm does a general ship and engine building business. It is regarded somewhat as a national concern rather than as an individual enterprise.

The only machine tool plant in Denmark of importance is the firm of Nielsen & Winther, and that establishment has already made a good beginning in the Continental export trade. Other prominent firms include the Atlas Works, the Titan Works, the Danish Rifle Works, the Government Rifle Works, and the Government Ammunition Works. All these firms are located in Copenhagen.

In Holland a similar condition exists as in Denmark, that is to say, the Danish plants are dependent on Germany or England for raw material.

On the occasion of my visit to the Netherlands Machine Works in Amsterdam, I learned that there was a quotation made that day to sell steel shafts, rough turned, for 26 marks ($6.19) per ton. The quotation came from the Witkowitz Works of Moravia. The quotation was regarded by the Amsterdam Works as extremely low. The coal used in the Netherlands comes largely from Germany. In 1909, the quotations were approximately $2.68 per ton.

In some of the Netherlands works the Westphalian coal is regarded as superior to the English eastcoast coal, and although it costs a little more, it is said that it yields more economical results. In the Amsterdam shops lathe men, planer hands, and milling machine men are paid from 9.2 to 12 cents per hour; boring mill hands receive from 8 to 11 cents per hour; and grinding-machine men 10.4 cents. Twelve cents per hour is the maximum paid the assembling-department hands. Molders and carpenters get 10.4 cents, and pattern makers average 12 cents an hour. The hours of work are from 7 A. M. to 12 noon, and from 1:30 P. M. to 6 P. M., except Saturday, when work stops at 12:30 P. M.

As an instance of the readiness of foreign plants to buy the latest equipment obtainable in America, the writer observed at the Florisdorf Locomotive Works near Vienna an American milling machine of Cincinnati make, which, it is understood, was one of the first tools of the type put on the market. The American tool cost considerably more than the standard German machine of similar design, but the former was purchased by the Florisdorf Works because of its superior merit.

The writer made every effort to ascertain what criticism, if any, existed abroad with reference to American machine tools. Inquiries in this direction were largely directed to those who actually used the machines in the shops. Not a few shopmen were of the opinion that too much cast iron is used in levers and wheels; that not enough attention is paid to bearings; that very often the cheapest grade of white metal is used, and, in consequence, the bearings run out very quickly. Attention was called to the fact that in some instances shafts were found running direct in the cast iron of loose pulleys of countershafts without being lined with brass. Still another criticism is, that main spindles often are not ground and hardened and that not enough attention has been paid for taking side pressure.

The writer is convinced that the criticisms do not apply to the best grades of American tools, and that, for the most part, complaints are either trivial in character or the importance has been exaggerated. Criticism is made that the quality of some of our makes in the past three years has been inferior to the standard of former years. This question can be definitely answered by each manufacturer for himself. Speaking generally, however, the European does not appreciate how to get all possible work out of a machine in a few years, nor do European shops follow the general American practice of writing off each year a certain percentage of the shop equipment and substituting in lieu thereof more up-to-date material. Notwithstanding all criticisms, even German competitors admit that American machine tools, with certain exceptions, perform better work than Continental machine tools in the same class, and as an illustration, a German manufacturer of machine tools only recently built a new shop and equipped it throughout with American machine tools.

The foreign trade may not be essential during good times at home, but certainly is an excellent balance wheel in poor times, when orders are not coming in from the home market. That firm is fortunate which during a period of depression has sufficient foreign orders in hand to hold together its organization. Foreign business when once secured should be jealously guarded and considered as a valuable asset.

Before the foreign trade can be developed, the manufacturer must have a knowledge of conditions as they exist abroad. This must be something more than a superficial knowledge, and it is on this point that so many of our firms are weak. American machine tools cannot be sold in Europe through the medium of correspondence; Americans must be exported with our machines and the foreign field entered seriously. Once it is determined to enter the European field, every care should be taken to send forward only the best machines. It must be borne in mind that shipments to Europe involve considerable time, and misunderstandings which may arise cannot be adjusted in a few days' time. The best American machine tools and all new and special tools, possessing merit rather than mere ingenuity, will always find a market in Europe.

The Largest Electric Valve in the World

By Frank C. Perkins

IN these days of commercial and technical achievement on a gigantic scale, there is hardly any department of the applied sciences which does not boast of some stupendous example, some mammoth structure, an imposing monument to the industrial civilization of our time. One thing leads on to another. If the vast strength of Niagara has been tapped by water power stations of unprecedented magnitude, the immensity of the thing extends down into what one hesitates to call the "detail" structures. For a valve which comfortably accommodates an automobile with five persons in its interior is rather a large "detail."

This nine-foot valve, which is shown on the front page, was designed and built at Indian Orchard, Mass. It is one of a set of three constructed to control the water driving hydraulic turbines of 12,000 horse-power each at the Niagara Falls Hydroelectric Station of the Ontario Power Company. The valves are of the Chatman type, weighing 65 tons apiece. Each is operated by an alternating current electric motor of 15 horse-power, three minutes being required for raising or lowering the gates, which are of cast steel. They are the largest electrically operated valves in the world. Each is 11 feet wide and over 30 feet high, the total thickness over the flanges being nearly 7 feet.

It may be stated that the body of the valve is of cast iron, and the valve gate, which is of steel, is designed for a pressure of 60 pounds per square inch or a total load of more than half a million pounds. For relieving the water pressure when closing or opening the valve a 14-inch by-pass valve is provided. There are guides provided for the nine-ton cast steel gates, with brass shoes for taking the wear between the guides and the gate, the latter being forced away from the guides at the instant of closing, resting against the bronze seat ring entirely, the water pressure holding the gate shut tightly. It is stated that this final seating upon the bronze ring is obtained by putting the seat in on an angle, giving the effect of an ordinary gate valve with wedge-shape club. The cast-iron valve bodies are heavily ribbed to withstand the high pressure, and the bronze valve seats are held in the body by bronze headless screws through the ring face.

The electrical equipment for operating this enormous valve gate and the operating mechanism is unique. The fifteen horse-power alternating current motors drive the spindles, which are over 12 feet long, through gearing. These spindles for raising the gate valve have threads of 2 inches pitch and are two in number, of Tobin bronze 4½ inches in diameter. There are automatic electric limit switches arranged at the top and bottom of the gate travel so designed as to make it impossible to start the motor in the wrong direction, and a unique magnetic brake is provided for instantly stopping the valve gate mechanism. In case the gate is part way open the electric motor may be restarted in either direction, but if the nine-ton valve gate is entirely closed the electric motor can only be restarted to raise the gate, and *vice versa*.

Correspondence

A Test for Vanadium

To the Editor of the SCIENTIFIC AMERICAN:

Having had some little difficulty in making rapid determinations of *vanadium* ores by the methods that have come to my notice, and never having seen the following simple and trustworthy method described, I believe it might be of interest to some of your readers.

Pound up the ore, and fuse it with about equal weight of caustic soda in a porcelain crucible. Cool, and then boil the crucible and contents in some water, preferably crushing first, but this is not necessary, and wastes the crucible. Filter, acidify slightly, and again filter, making sure that the solution is slightly acid.

Add ferro-cyanide of potassium, and the presence of vanadium is readily shown by a flocculent apple green precipitate, which quickly subsides. After this is once performed with a mineral known to contain vanadium, there can be no confusion. Nothing interferes.

This treatment of vanadium ores may be advantageous on a commercial scale, and if so, all rights to do so, and all rights, title, interest to this discovery if new—and so far as I know it is—are hereby given to the American public. F. WEBB.

San Diego, Cal.

A Geometrical Problem Attacked

To the Editor of the SCIENTIFIC AMERICAN:

With reference to a copy of your honored journal of 9th July, 1910, I noticed, on page 27 in the correspondence column, a geometrical problem set forth by Mr. Herman L. Schimpff, where he thinks he has found a new way of dividing a line of determined length into any number of equal parts.

As I have not noticed any correction of the new proposition propounded in any of the subsequent numbers of the SCIENTIFIC AMERICAN, I am induced to draw your attention to the absurdity and impossibility of Mr. Schimpff's scheme.

Had his statement been correct, then the long sought for solution of the problem of equal trisection of any angle would have been found..

Hongkong, China. R. TH. SJÖSTEDT.

Solar Energy

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in the Fessenden scheme for utilizing solar energy recently depicted in your paper, but not less astonished at the statement in the sub-title that the highest temperature so far reached by such means was 65 deg. C. I was therefore very glad to see the mistake corrected by Mr. Fessenden himself in a later issue. But now comes along another correspondent in the February 18th number, and blithely states that, "Any schoolboy knows that the rays of the sun can never raise water to the boiling point of 212 degrees without the use of condensing mirrors or lenses." Now it may be true that this is common schoolboy knowledge, but like much else that every schoolboy knows, entirely mistaken. In fact it is very difficult to perceive how some people come to their remarkable knowledge, certainly oftentimes neither from their own experience nor reading. Many people have a way of deciding things for themselves, and having done so, are more satisfied with the results than if the greatest light of the age had personally instructed them. I once knew an estimable old lady to whom I happened to remark that the melting point of platinum was nearly 2,000 deg. C. "Why that is impossible," she exclaimed. "There aren't so many degrees as that." "How many do you think there are?" I asked. "At most two hundred," she replied, and nothing could persuade her that there could be any more. She had decided the question for herself and that settled it. There was no shaking her certainty with regard to it.

Now on page 52 of Arrhenius's "Worlds in the Making" we read: "Langley made an experiment with a box, which he packed with cotton wool to reduce loss by radiation, and which he provided, on the side turned toward the sun, with a double glass pane. He observed that the temperature rose to 113 deg. (235 deg. F.), while the thermometer only marked 14 deg. or 15 deg. (57 deg. or 59 deg. F.) in the shade. This experiment was conducted on Pike's Peak, in Colorado, at an altitude of 4,200 meters (13.789 feet), on September 9th, 1881, at 1 hr. 4 min. P. M., and therefore at a particularly intense solar radiation."

Every competent physicist, in fact, well knows that the temperature to which a body will rise when exposed to radiation of any sort depends merely upon the balance between heat received and heat lost. If all heat loss could be prevented, there would be no theoretic limit to the attainable temperature, except that of the radiating body. Hence practically it is merely a question of good insulation, and of the interposition between the radiating and the absorbing body of a medium permeable to short waves, but opaque to long ones. Langley used merely a double glass plane, but there are other substances much better adapted to the purpose. Nor is cotton wool the best insulator. Langley's was decidedly a rough experiment, a mere side issue in a more important investigation. With more refined means, there is nothing absurd or improbable in the attainment of temperatures much above the ordinary boiling point of water by direct solar radiation, all schoolboy knowledge to the contrary notwithstanding.

There is a widespread popular fallacy closely connected with this question, which it may be useful to mention here, viz., that the sunlight has a definite *temperature*, and that a thermometer put out in the sun measures that temperature. As a matter of fact the temperature that such an instrument will indicate depends entirely upon the nature of the instrument. Different thermometers will give entirely different readings in the sunlight. Blacken the bulb of one of them and the mercury will rise, though everything else remains the same. The reading obtained merely shows the temperature at which the heat lost or radiated away equals that absorbed, and has nothing to do with the temperature in the sun. The latter expression has no meaning.

Waterville, Maine. F. MOTT SMITH.

The Need for Standard Wire Gages

To the Editor of the SCIENTIFIC AMERICAN:

The item in the SCIENTIFIC AMERICAN of February 11th, page 15, regarding wire gages, touches an important matter. The present confusion in wire gage sizes should not have been tolerated for so many years, but it is not too late to apply a remedy.

The following facts, explaining some of the points involved, will, I trust, be of sufficient interest to obtain space in your columns.

The use of so many different gages is one of the most annoying perplexities in the wire and sheet-metal business. There are no less than five different gages in common use in the wire and sheet-metal trades in the United States, not to mention the English Imperial standard gage, screw gage, etc. For instance, a customer may order a lot of springs of No. 10 gage wire, of course not thinking it necessary to mention what gage he uses. The manufacturer should know these details by telepathy or by some other intuitive method! As a result, the springs might be made of any one of the following sizes of wire: Am. or B. & S. gage, 0.10189; Birmingham or Stubs, 0.134; Washburn & Moen, 0.135; Stubs steel wire, 0.191; U. S. sheet gage, 0.1406; and if music wire gages are included, 0.026, 0.024 or 0.0236.

To obviate this difficulty as much as possible, most spring makers have adopted the W. & M. gage, and use it for all steel wire springs (except those of music wire), when no gage is mentioned.

The Brown & Sharpe gage, or the American gage, is the standard gage adopted by makers of brass wire and sheets, but confusion is caused by much brass wire being still drawn to Birmingham gage.

In England this same confusion obtained for years to a much greater extent than in the United States, no less than forty-five different gages having been used to measure wire. (For a full discussion of the gage question in England see "Wire, Its Manufacture and Uses," by J. Bucknall Smith, C.E., pages 125-131.) This condition caused the matter to be taken up by the manufacturers, which resulted in the formal adoption by the law of the "Imperial standard wire gage." While the Imperial gage is the only legal wire gage in England, yet some manufacturers still use the Birmingham gage.

In the United States no successful effort has been made toward the adoption of any standard gage for wire. Sheet makers have a standard gage, Congress having adopted the "U. S. standard gage for sheet and plate iron and steel" on March 3rd, 1893.

The Brown & Sharpe gage is generally used for brass sheet and wire; Birmingham or Stubs, Brown & Sharpe, and Washburn & Moen gage for iron and steel wire, and Stubs steel wire gage for drills and drill rods. In all of the above gages the size decreases as the number increases, for instance, No. 5 is smaller than No. 4. In music wire and screw gages the reverse is true. Even in music wire there is no uniformity, the several gages used by English, German and American makers showing considerable variation.

The refinement to which some of the gage sizes are carried is astonishing. Millionths and even ten-millionths of an inch occur. It is not so much a question of the relative desirability of the different gages as it is the broader question of adopting some gage as standard for all kinds of wire, so as to avoid the confusion and loss often caused by the present conditions.

A simple and effectual remedy has been proposed, viz., to use the micrometer alone for gaging wire. When sizes are expressed in decimals there is no confusion, 0.093 meaning just the same to the user of the B. & S. gage as to the user of W. & M. or any other gage.

Certain sizes could be designated as standard or regular for convenience in drawing wire and to avoid a multiplicity of sizes. This arrangement would do away with all half and quarter sizes, which are sometimes the cause of misunderstanding at present. For instance, the writer has often found a great lack of assurance as to the actual position of No. 0½ in the scale of sizes. A decimal arrangement can be made, taking into consideration all the gages in general use, and with a comparatively small number of changes in actual sizes, the change being mainly in the nomenclature.

F. E. WHITTLESEY,
Secretary and Treasurer Raymond Mfg. Co.
Corry, Pa.

The Nantucket Windmill

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 28th appears an article on Nantucket's famous windmill, by Allen Day. While the article is excellent in many ways and very interesting to the average reader, in that it deals with a business of the historic past, I fear it conveys a false impression, and carries with it the inference that the mill is still in operation.

As a matter of fact, the mill has not ground any corn for a quarter of a century; and although its mechanism, which the SCIENTIFIC AMERICAN so fully describes, is complete, it would not be feasible nor safe for the mill to be started without the expenditure of quite a large sum of money in making repairs, and replacing badly worn parts.

The last miller was an old Portugese named John Francis Sylvia, and he had for an assistant the late Peter Hoy, a veteran of the civil war who died last summer. While the mill was actually operated by Sylvia up to the early 80's, the business which it once had was gone long before that period, and the last time its big vanes were set in motion to grind corn was a few months before Sylvia's death, when a couple of bushels were carried to the mill and ground into meal, which was then sold in small paper bags at ten cents each, for souvenirs. I doubt very much if any of those little bags of meal are in being to-day; if so, they have historic value, as the meal is actually the last ever ground by Nantucket's old mindmill.

The old landmark is now owned by the Nantucket Historical Association, which opens it each summer as a sort of museum. Whether its vanes will ever be set in motion again is very doubtful, but it is assured that the mill and its peculiar mechanism will remain intact for many years to come. HARRY B. TURNER.

Nantucket, Mass.

Wanted: A Trimming Machine for Paper Hangers

OBSERVE a paper hanger on a job calling for good work and you will notice him paste the paper, then fold it upon itself, pasted surfaces inside. Then pressing a straight edge firmly upon the folded paper just back of the marginal strip, he will, with a keen knife, cut off the strip; or, in paper hangers' parlance, trim the paper. Paper of a cheap grade is frequently trimmed by machine in the shop, before being taken to the job and before the paste is applied. For a while the writer of this note was at a loss to understand why it was not better to trim the paper by machine, as it seemed it could be machine cut more accurately than by hand. A friend, a master paper hanger, doing first-class work only, explains it as follows: If you paste paper to the edge and put it on the wall, a small portion of the paste is likely to squeeze out at the joint and smear. In hand trimming, the pressure of the straight edge squeezes all surplus paste out into the marginal strip which is trimmed off, leaving no excess to smear in hanging the paper. It may be practicable to devise a combined pasting and trimming machine which will paste the paper, press out the surplus paste and then trim the paper accurately and with greater facility than by hand.

The Current Supplement

THE reasonable use of materials in the construction of automobiles is the subject of the opening articles of the current SUPPLEMENT, No. 1835. The author of the article, Mr. Henry Souther, makes a particular point of discussing the selection and treatment of alloy steels.—Charles Janin writes on the gold dredging industry, and points out its limitations and its possibilities.—The famous astronomical clock of Venice is described by Mr. Charles A. Brassler in an illustrated article.—Ethel Claire Randall writes interestingly on the pygmy people of Africa.—The eminent Dutch physicist, Prof. Van der Waals, who has recently received one of the Nobel prizes, is made the subject of a biographical article.—Mr. J. A. Hardcastle discourses interestingly on migrating stars, with particular reference to modern star drift theory.—Dr. E. F. Phillips' admirable monograph on making money out of bees is concluded.

Perfume Statistics from a Botanist

ACCORDING to the investigations of a German botanist, out of forty-three hundred species of flowers cultivated in Europe only four hundred and twenty possess an agreeable perfume. Flowers with white or cream-colored petals, we are told, are more frequently odoriferous than others. Next in order come the yellow flowers, then the red, after them the blue, and finally the violet, whereof only thirteen varieties out of three hundred and eight give off a pleasing perfume. In the whole list, as compiled by this authority, thirty-three hundred and eighty varieties are offensive in odor, and twenty-three hundred have no perceptible smell, either good or bad.

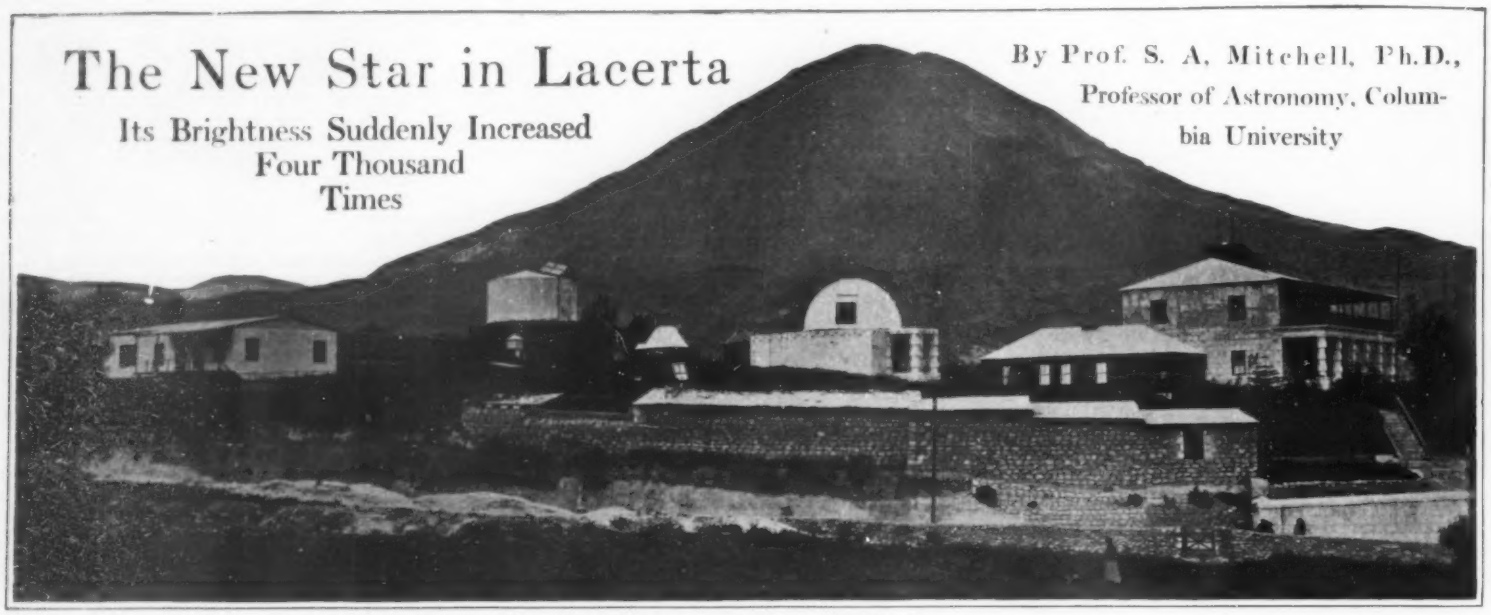
Catgut from Silkworms

PROBABLY but a small percentage of the fishermen who use flies strung with fine translucent "cat-gut" are aware that the almost unbreakable substance that holds the hooks against the fiercest struggles of the struck fish comes from silkworms. The principal center of the manufacture of this kind of cat-gut is the island of Procida in the Bay of Naples, but most of the silkworms employed are raised near Torre Annunziata, at the foot of Vesuvius. The caterpillars are killed just as they are about to begin the spinning of cocoons, the silk glands are removed and subjected to a process of pickling, which is a secret of the trade, and afterward the threads are carefully drawn out by skilled workers, mostly women. The length of the thread varies from a foot to nearly twenty inches.

The New Star in Lacerta

Its Brightness Suddenly Increased Four Thousand Times

By Prof. S. A. Mitchell, Ph.D., Professor of Astronomy, Columbia University



The Harvard College station at Arequipa, Peru.

THERE is no science which shows the wonderful power of the human intellect as well as does astronomy; there is no branch of astronomy so full of strange surprises as the study of the light-variations of stars. Some of these changes are of everyday occurrence, which may be predicted with the accuracy of an eclipse; some change irregularly and at long intervals; while some seem to concentrate their whole life into one amazing outburst, where in a few days or hours a star's light is suddenly increased a thousand, or even ten thousand fold. Stars which blaze forth so quickly are called "new" stars, or "novæ," and interest in them has been lately much aroused by the discovery of no less than four in the last three months of the year just passed.

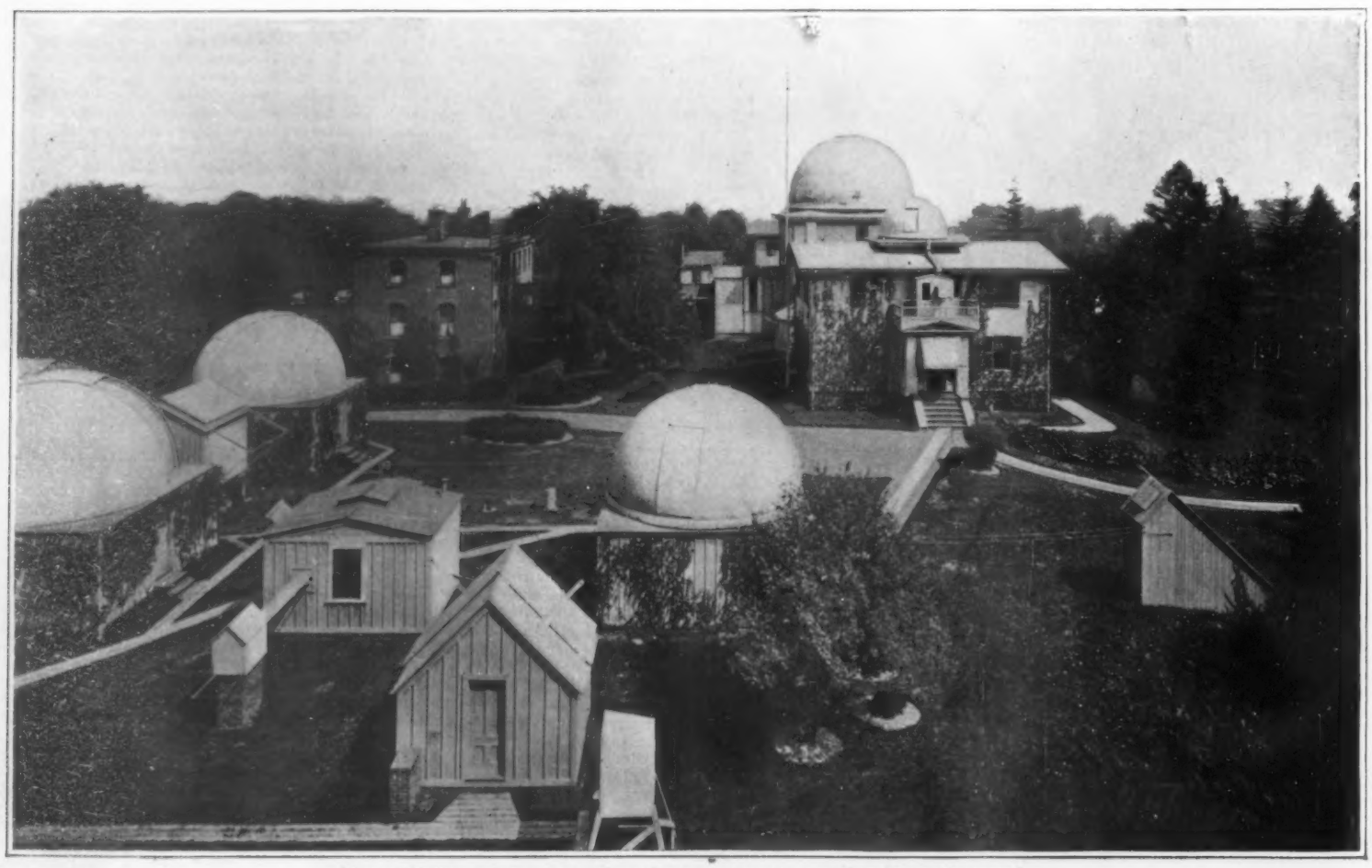
Of these four the most interesting is the one in the constellation of Lacerta, discovered by the Rev. T. E. Espin of Dunham, England, on December 30th, 1910. This star, now known as Nova Lacertæ, is found in the Milky Way, between the constellations of Cassiopeia and Cygnus, and forms the apex of a small equilateral triangle, with the stars of β and α Lacertæ on the edge of the Milky Way as the base. In view of the many problems still unsolved concerning new stars, this star at the present writing forms the chief object of interest in the stellar environs for professional astronomers all over the world.

Since the beginning of astronomy, only 36 new stars altogether have been discovered, of which number exactly one-half were discovered up to the year 1885. The first new star in history was that seen in the constellation of the Scorpion, in the year 134 B. C., by the greatest astronomer of antiquity, Hipparchus. The most brilliant star yet seen was that which appeared to Tycho Brahe on November 11th, 1572. Its brilliancy was so great that it could be seen even at noon. Its color at first was white, then red, but it paled in color as after three weeks it began to lose its brightness. The number of new stars found in the past twenty-five years equals that found in the two thousand years previously. The importance of photography is here shown by the fact that no less than fifteen of the eighteen stars were revealed by the photographic plate. Fourteen of these fifteen were discovered at the Harvard College observatory from a study of plates made at Cambridge or at their southern dependency in Arequipa, Peru. Ten of the Harvard College discoveries are due to Mrs. Fleming, two to Miss Cannon and two to Miss Leavitt. It is probable, however, that the discovery of a new star from photographs may not be made until after the most interesting period is past, and it is even possible that such a discovery should not take place till years after the star blazed forth. A new star discovered by Miss Cannon, of Harvard, on November 12th, 1910, was from photographs made more than ten years previous to that date on August 10th, 1899.

On the night of December 30th, 1910, Espin noted a star in Lacerta not found on the star charts, and on examining it with a small spectroscope he found a peculiar spectrum of bright lines. Thinking he had discovered a rather unusual variable star, the news was telegraphed to the Greenwich observatory, who in turn cabled to the Harvard College observatory. Prof. Pickering, on looking into his splendid storehouse of plates, found that the star did not appear on a photograph taken on November 19th, but on November 23rd the star was of the fifth magnitude. When discovered by Espin, it was already on the wane, for it was of the seventh magnitude when first observed by him.

An examination of plates taken by Prof. Barnard, of Yerkes observatory, and Prof. Max Wolf, of Germany, shows that the new star had been previously photographed by these eminent astronomers; as early as 1893 by Prof. Barnard, when it was of the fourteenth magnitude. Between the 19th and 23rd of November, the star increased its brilliancy 4,000-fold.

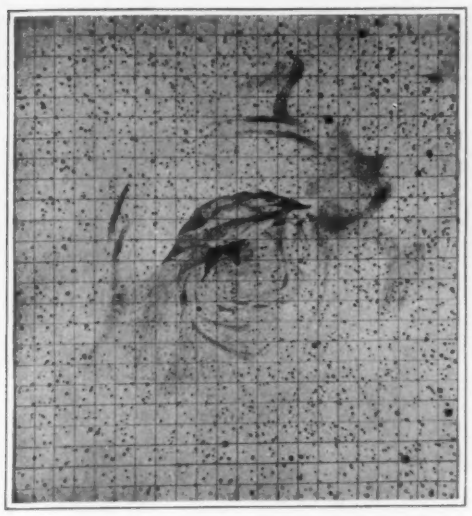
As long as astronomers had merely the changes in the star's light to guide them, no satisfactory theories for the causes of new stars were obtainable. They were able to describe the facts, but could give no adequate explanation of them. The addition of the spectroscope to the telescope gave a powerful instrument of research. To give a legible spectrum, one to be permanently recorded on a photographic plate, there was necessary a star of some brilliancy, and it was not till the outburst of Nova



Harvard College observatory, where fourteen "new" stars have been discovered.

Aurigæ in 1892, that a satisfactory test of spectroscopic theories could be made. What remarkable surprises the spectroscope did then record!

On February 1st, 1892, Dr. Anderson, of Edinburgh, discovered visually a new star in the Constellation of the Charioteer. Photographic plates being then consulted, it was found that the star had been invisible on December 8th; forty-eight hours later it was of the fifth magnitude, while on December 20th the star was of the 4.4 magnitude; so that for nearly two months the star shone with a brilliancy which could have led to its detection by anyone acquainted with celestial geography. The spectroscope



Nebulosity about Nova Persei September 20, 1901. After a photograph made at Yerkes observatory.

immediately applied to Nova Aurigæ showed startling peculiarities. The spectrum was seen to blaze with bright lines, those of the hydrogen series and helium set being most conspicuous. Most of the bright lines have had dark companions on their violet side. Here, to the astronomer, was a shift in position in the lines of the spectrum, and this could be explained by only one supposition. This hypothesis was that two stars had collided in space, one, a bright-line star, receding from the earth with the speed of 230 miles per second, the other a dark-line star, approaching us with a velocity of 320 miles. The brilliant light was supposed to come from the impact of these two stars at the speed of 550 miles per second. But future events did not bear out this hypothesis, for the bright and dark lines in the spectra retained their relative positions unchanged, or in other words, the two stars kept up their same relative speeds. For this to be so, their gravitational force must have been at least 15,000 times that of the sun! Other incongruities appeared, so that the theory of the colliding stars was inadmissible and had to be dropped. What other theory is there to take its place? The peculiarities in the spectrum of Nova Aurigæ are shown in the photograph to be seen at the Harvard College observatory.

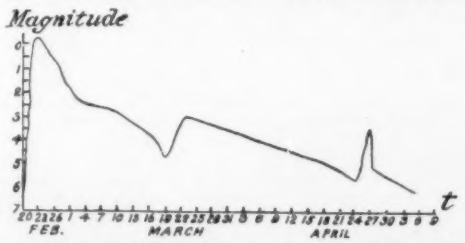
Instead of looking more closely into the light history of this interesting star, let us turn to a more brilliant one of the same class, which ranks next to Tycho Brahe's star as the brightest of its time. The same Dr. Anderson, who has discovered Nova Aurigæ, on February 22nd, 1901, noticed a star in the contellation of Perseus outrivalling the brilliant star Algol. Twenty-eight hours previous to this, photographs by Mr. Williams showed there no star as bright as the twelfth magnitude. Dr. Anderson was more lucky with his second discovery, for he caught the star Nova Persei on the rise. It gained light rapidly after its discovery at Edinburgh, and on February 23rd even exceeded Capella in brilliancy. Its light quickly dwindled, and by the following day it had lost one-third of its light. It continued to lose its light gradually, but with an occasional sudden brightening as is shown in the attached diagram.

Here at last was a brilliant star on which it was possible to test spectroscopic theories. And what curious results the spectroscope revealed! To begin with, the spectra at first showed the ordinary Orion type with faint dark lines of hydrogen and helium. According to astronomers such a spectrum marks a star in an early stage of development. The new star then appeared blue to the eye. On the day following the maximum of February 23rd, however, the character of the spectrum was completely and absolutely changed. Bright lines now appeared, the same spectrum was seen as in Nova Aurigæ, with the bright lines accompanied on their violet sides with dark companions. On the assumption of bright and dark star colliding, the impact would have been at the rate of 1,000 miles per second! Such an impact might occur once—though the chances are many against it—but for such impacts to keep on recurring, and at such terrific speeds, is clearly inadmissible. Some other explanation must be found. The appearance of the brilliant bright-line spectrum caused the star to have a red color. The star gradually became less red as the days passed, and as the star diminished in brilliancy. The spectrum was likewise modified as the star declined. The dark lines became less prominent, and two weeks after the most brilliant period, had disappeared altogether. The bright lines now shone without dark companions. These lines gradually changed in appearance, some of the lines disappeared, new ones appeared, till in August the star's spectra shone with a series of bright lines which are the exact counterparts of those observed in planetary nebulæ. While these changes were going on, the star's color altered from red to orange and finally to a deep blue.

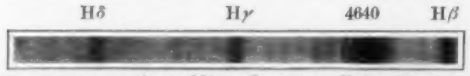
Such then were the peculiar changes in the spectrum of Nova Persei, the brilliant new star of ten years ago, and these were the exact reproduction, but on a brighter scale, of what had gone on in Nova Aurigæ.

Strange as were the spectrum changes, they were no more curious than what was revealed by long exposure direct photographs. By using the reflecting telescopes at the Lick and Yerkes observatories, Perrine and Ritchey, respectively, showed simultaneously that Nova Persei was surrounded by a far-reaching nebula which showed great peculiarities southeast of the new star. A comparison of two drawings from photographs at the Yerkes observatory made September 20th and November 13th, 1901, show that the nebula was expanding outwards and increasing in size. In examining the two drawings it will be readily seen that the strong condensations above and to the right of Nova Persei, which is shown in the middle of the drawing, are moving away from the star. This change may readily be seen by counting the squares. Here is an unprecedented change. What is the reason? Kapteyn and Wilson independently brought forth the explanation that the nebular changes proceeded outward from Nova Persei with the velocity of light. In other words, the sudden outburst of light from the new star proceeded outward through space, illuminating as it did dark nebulous matter spread through space like the wispy clouds. Though there are difficulties in the way of this explanation, it is the best we have. If this is correct, then the star must have blazed out three hundred years previously, and the star was so far away it took light traveling at the rate of 186,000 miles per second this length of time to reach us! And if this distance is the correct one, the star at its maximum was 8,000 times more brilliant than our own sun!

Though at its maximum brilliancy on November 23rd, Nova Lacertæ was not discovered till over a month later



Light changes of Nova Persei February to April, 1901.

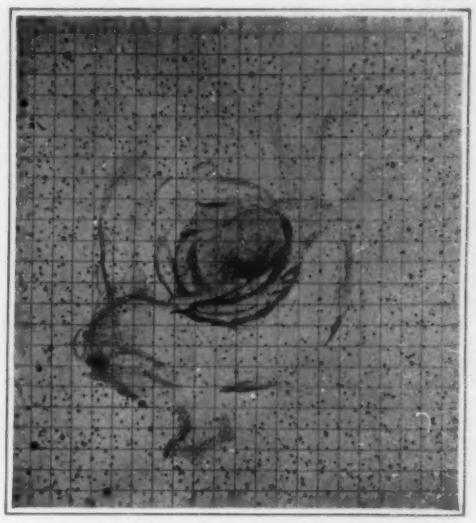


Spectrum (negative) of Nova Lacertæ. Taken January 3, 1911, by Frost, at Yerkes observatory.

on December 30th, 1910, when its light was on the decline. A spectrum was obtained at the Yerkes observatory by the director, Prof. Frost, on January 3rd, 1911, by means of the spectrograph attached to the great 40-inch telescope. This spectrum reproduced above shows the bright hydrogen lines Hδ, Hγ and Hβ with dark lines on the light or violet side. This appearance with the broad band at wave length 4640 is exactly analogous to that observed in the case of Nova Aurigæ and Nova Persei, at corresponding stages of progress. Prof. Barnard, using the 40-inch visually, found that at the principal focus of the great lens the Nova was of a whitish color with crimson glow around it, which agreed essentially in appearance with an ordinary star. One-third of an inch farther from the object glass appears a beautiful crimson image of the star, as sharp as the first one, surrounded by a greenish halo. This appearance noted before by Barnard, in another new star, Nova Geminorum, is caused by the concentration of the crimson light from the red line of hydrogen. The exact position of Nova Lecertæ is 22 hrs. 39 min. 11.79 sec., and 52 deg. 15 min. 19.8 sec. north.

The most notable features of the new stars are as follows:

1. Three have appeared in nebulæ, and all, with but one exception (Nova Coronæ) have appeared in the Milky Way.



Changes in nebulosity of Nova Persei apparent on November 13, 1901. From photograph taken at Yerkes observatory.

2. The stars are all very remote since they show no parallax.

3. They quickly rise from obscurity and slowly sink back again to obscurity.

4. They show first the spectrum of a star in its first stages of development.

5. Then appears the spectrum something like that of the solar chromosphere with bright hydrogen helium lines with dark lines on the side of shorter wave-lengths.

6. The color of a new star is first bluish white, then red, slowly changing to orange and then to blue or white.

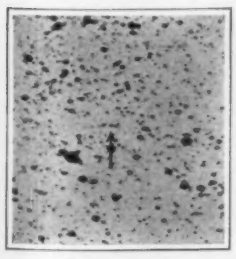
7. The spectrum changes in character till it becomes that displayed by a planetary nebula.

8. In Nova Persei, a nebula became successively illuminated.

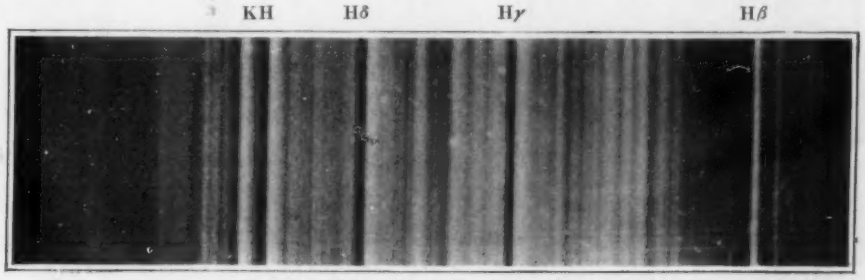
Any adequate theory of new stars must take account of the above facts. The spectroscopic stages are not mere transitory phenomena, but have their several changes exactly matched by permanent stars in the sidereal universe. For instance, the star P Cygni shows the bright and dark lines side by side as does also β Lyræ. A cause for a blazing out of bright spectrum lines could not be accidental in new stars, and act continually in other stars. New stars cannot be caused by the collision of a bright and a dark star. Nor can we assume that they are caused by the sudden explosion of gases imprisoned in the hollow shell of a star. (This theory has been advanced.) If the star was an ordinary looking star before the explosion its spectrum would consist of an ordinary dark line spectrum. The liberation of gases under great pressure and their appearance due to the explosion would give a spectrum of bright lines. The waves coming from a gas under pressure would be shortened in length and bright lines would appear on the violet side of the dark lines instead of on the red side.

The only rational explanation is that a star moving with moderate speed in the Milky Way encounters a widely spread out nebula which before was so faint that it had not been detected by our photographic plates. The star passing through the nebulous material behaves like a meteor passing through our atmosphere, it becomes suddenly luminous and exhibits the bright line spectrum. As soon as it has passed through the densest parts of the nebula its light begins to wane, and continues to decline except when the star encounters some outlying small portions of the nebula, when the star suddenly brightens up for a short time.

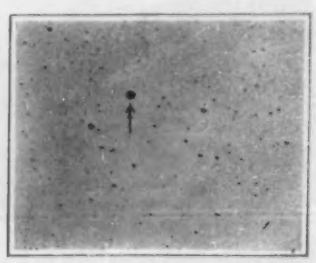
Truly "one star differeth from another in glory," and great is the human mind that can unravel those strange mysteries!



Nova Sagittarii, August 3, 1899



Spectrum of Nova Aurigæ, photographed at Harvard College.



Nova Sagittarii, August 10, 1899.

NEW STARS AND THEIR MEANING

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

Carriers of Plague

TECHNICALLY any animal is a carrier of plague which has plague, and in the organs or blood of which the plague bacillus resides. In that sense the natives of India are plague carriers; the rats and bandicoots of India are still more emphatically plague carriers. But, in the last resort, seeing that the instances in which a rat suffering from plague could inoculate man with plague bacilli must be so rare as not to be worth considering, the true carriers of plague are the animals which convey the bacilli from rat to rat, or from rat to man, or, in rare instances, from man to rat. These animals are the fleas which infest rats.

This conclusion, apparently so simple, was, however, not reached without long continued investigations, undertaken, at the instance of the Indian government, by a commission of bacteriologists (under the direction of Dr. C. J. Martin, F.R.S., and Col. David Bruce, F.R.S.), which has been at work since 1904. The results of that commission's work are summarized by E. S. Grew in *Knowledge*. Among the investigations made by the Plague Commission's bacteriologists have been a number which dispose of the idea that plague can ordinarily be spread by plague bacilli which may be left on the earth—on the floor of infected houses, or on the soil. Nor can plague be transmitted usually by aerial infection. That is to say, it cannot be transported through the air, or with wind-swept dust. Nor, again, though this belief has had a long currency, can it usually be transmitted through food. The Indian Plague Commission have discovered no fact which would support the suggestion that plague may effect an entrance into the human organism through the stomach or intestinal canal. The probabilities of infection through swallowing any number of plague bacilli are extremely small; and it is justifiable to conclude that in nature, infection of rats by feeding rarely or never takes place, and that rats do not become infected by eating the carcasses of their comrades. The repetition of these

Fig. 7.—Pulex felis, the cat flea.

Fig. 8.—Sarcopsylla gallinacea, the chicken flea.

facts has a certain interest at a time when the appearance of plague among rats in Suffolk has created a very distinct prejudice against the use of game, of hares, and even of imported rabbits as food. Every one would, of course, prefer not to eat any animal which could possibly have died from plague, but no one would be in the least likely to contract plague by doing so.

In view, however, of the fact which is now declared by the highest authority to be well established, that there have occurred two cases of plague pneumonia in Suffolk, and that there have been a number of cases of plague among rats in that neighborhood, it becomes important to inquire what the probabilities are of any considerable spread of the infection in England. "In any outbreak of plague in a new locality," says Mr. Grew, "the factors which determine the extent and severity of the epidemic are much more numerous than are generally supposed, and the margin between danger and safety is dependent on factors which are in themselves apparently slight. For example, it has already been

Fig. 1.—An old Bengalpura street.

All the dwelling houses are above stables and therefore, on the face of it, likely to be infested with rats.

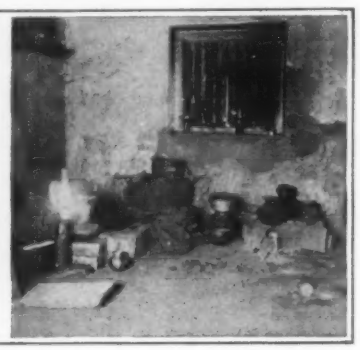


Fig. 2.—The interior of a coolie's room.

Pots and boxes containing articles of daily diet are lying all over the place and affording shelter and facility to rats.

said that plague is spread entirely by plague fleas. This may naturally lead to the inquiry whether the last Great Plague of London, which proved so devastating, was spread by fleas? If it were so would not this argue that the habits and dwellings of London in the late seventeenth century were much more dirty than we have any evidence to show that they were? Moreover, would not the supposition be in conflict with the recorded facts that whole families were stricken with the plague, apparently taking it from one another? That is certainly true; and the answer to these questions is to be sought in the fact that plague has more than one development. It may develop into plague pneumonia, which, of all forms of plague, is the most dangerous and the most infectious. The mortality in plague pneumonia approaches one hundred per cent; hardly anyone recovers from it. Moreover, while suffering from it the patients are delirious, they are with difficulty restrained from walking about, and they cough incessantly. Their sputum is full of plague germs, and is highly infectious to anyone on whom it may be discharged. Rats, also, may have plague pneumonia; and there is one instance at any rate in which a bacteriologist is believed to have contracted plague from the sputum of a plague infected rat. The Great Plague of London took place in winter, and a large number of victims no doubt had plague pneumonia; hence the virulence and rapidity of the contagion.

"What then is the genesis and progress of an outbreak of plague? Plague, in the first instance, appears to arise in certain foci in Asia and Africa, where it always exists. In a locality such as Bombay, an outbreak among human beings is preceded by an outbreak among rats, and if a curve be drawn showing the rise, culmination and decline of the plague among rats, it is found that a rise, culmination and fall of plague among human beings takes place in a curve almost parallel to that of the plague among rats, but occurring about a fortnight later. The reason is quite plain. In the native dwellings of India generally, and in the native villages of the Punjab, man and the rat live together like friends. There are two kinds of rats in India, as there are two kinds of rats in England, though the numerical proportions of the two kinds are usually reversed. In England the commonest rat is the so-called gray rat, *Mus decumanus*, or Hanoverian rat, which usually inhabits sewers, and is a fierce, strong animal, shy of human beings. In India the commonest rat is the black rat, *Mus rattus*, which is not at all shy, and which, being allowed to do so, lives on terms of intimacy with the Indian native, But the black rat is found in England in the Thames and Mersey warehouses; and the gray rat is found in Indian ports. The reason why the black rat spreads plague in India is that it dwells unmolested in the native villages, and in the ramshackle native quarters of towns; and that, consequently, if it has any epizoötic disease which can be transmitted to man, there is an initial probability of its transmission. In short, the Indian rat is a reservoir of plague which is constantly being tapped by the fleas which live on it, and which carry it on to the human being in the rat's neighborhood. On a rat infected with plague thirty fleas are by no means an excessive number. In one native house in Parel, an Indian village, no fewer than three hundred rats were trapped. Multiply the number of fleas by the number of rats, and the number of possible plague inoculators thus arrived at will give an indication of the risk which Indian natives run of contracting plague when there is an outbreak of it among rats.

"It will be seen, therefore, that even if there were an outbreak of plague among the rats of Suffolk, the chances of the development of a corresponding outbreak are not very large. But they are further narrowed by the kind of fleas which live on rats in this country and in these latitudes. There are six kinds of fleas which have been found on rats. The human flea (*Pulex irritans*) is found on it sometimes, but not very often. The dog flea (*Pulex canis*) is found more often but still seldom. The mouse flea (*Ctenopsylla musculi*) (see Fig. 9) is also found.

"There are, however, three kinds of fleas which are found commonly on rats, and the consideration of which is more particularly relevant to the question of the contagiousness of plague. The first is a rat flea, *Typhlopsylla musculi* (not unlike the mouse flea), which is common on rats in some parts of Europe; but which will not bite

Fig. 9.—Ctenopsylla musculi, the mouse flea.

Fig. 10.—Ceratopsyllus fasciatus, the European rat flea.

man. The second is the most common European rat flea, *Ceratopsyllus fasciatus* (see Fig. 10). But this flea will not feed on man, except when starving. The last and most important flea is *Pulex cheopis*, the Indian rat flea, which, unlike the European rat flea, readily feeds on a number of animals. In the absence of rats it will readily bite man.

"It will be seen at once how important this factor is. The varying appetite of the different kinds of fleas modifies to a great extent the probability of the transmission of plague to man. If it were possible, or probable, that the European rat flea should alter its habits and adopt man as a host, the probability of human plague in Europe

Fig. 3.—The house (at Parel) with the plant pot in front produced a very large number of rats.

Fig. 4.—An examination of plague-infected rats at one of the Indian Government laboratories.

Fig. 5.—Taking a systematic count of the number of fleas parasitic upon rats in India.

Fig. 6.—Natives in India picking off fleas from live rats for the Government experiments.

'CARRIERS OF PLAGUE

would be of an entirely different order. At present northern Europe, and to a less extent, Europe in the temperate zone, seems immune from an outbreak of plague on account of the habits both of the gray rat and of the flea which lives on it."

Preserving Eggs With Water-glass

EGGS in large quantities are successfully kept in cold storage for many months, but this method cannot be employed by small dealers or housekeepers. Of the numerous chemical processes which have been devised, only two, the water-glass and lime-water processes, have been generally adopted. No satisfactory explanation of the preservative action of water-glass (sodium silicate) has yet been given. The simplest theory is that the pores of the egg shell are stopped by a precipitate of gelatinous silica and that the solution of one part of water-glass in 15 parts of water protects the eggs from the air and from bacteria. The colloidal solution cannot traverse the membrane which covers the egg. A mixture of water-glass and calcium carbonate hardens in the air, although no chemical reaction, causing the formation of calcium silicate, takes place. R. Berger concludes from his experiments, published recently in the *Zeitschrift fuer Chemie und Industrie der Kolloide*, that the product which is formed from the water-glass and the calcium carbonate hardens in the air, although no absorption occurs, and stops the pores. Solutions of soap and other colloids were found to exert a similar preservative effect on eggs. The best result was obtained with a mixture of water-glass and a 10 per cent solution of rosin soap containing the smallest possible excess of soda. The temperature of the water-glass was 120 to 125 deg. F.

Fog and Fog Signals

UNDER the above title Professor Alexander McAdie has written an interesting illustrated article which is published as a supplement to the Weather Bureau's "Meteorological Chart of the North Pacific Coast" for April, 1911.

Especial attention is given to the fogs of the Pacific, especially those of the coasts of California, Oregon and Washington, where the frequency of fog is the greatest menace to navigation. The harbor of San Francisco is notorious for its fogs. On summer afternoons the wind in this vicinity rises, with almost clock-like regularity, to about 22 miles an hour, blowing in from the sea, and a solid wall of fog, averaging about 1,500 feet in depth, comes in through the Golden Gate, causing a fall in temperature to about that of the sea, viz., 55 deg. F. The upper level of the fog can be plainly seen from the higher surrounding hills. Above it the sky is cloudless, and the air has a temperature of from 80 degrees to 90 degrees.

The winter morning fogs of the same region—commonly known as *tule* fogs, because they form over the overflowed bottom lands of which the tule is the characteristic plant—are quite different; they move seaward, and are relatively shallow, so that it is nearly always possible by sending a lookout aloft to get above them and secure proper bearings. With the summer afternoon fogs this is impossible.

Fog sometimes occurs at one time along the entire Pacific Coast of the United States. How far it extends seaward is not definitely known; the average distance is estimated at fifty miles, but in some instances it is several hundred miles.

Besides the ocean fogs and the tule fog, a nondescript smoke fog occasionally occurs at San Francisco, the fog moving seaward during the forenoon and returning as a dense black pall shortly after noon.

One of the foggiest months on record was October, 1903, during which fog signals were in use at the lighthouses along the California coast from 200 to nearly 300 hours.

Before the introduction of submarine signals, marine disasters due to the frequent inaudibility of fog signals from sirens were of common occurrence in the harbor of San Francisco. The most memorable of these was the loss of the Pacific Mail steamship "Rio de Janeiro," which was wrecked on the Fort Point Reef during a fog on February 22, 1901. One hundred and twenty-seven lives were lost. The pilot was unable to hear the fog signals from either Point Bonita or Lime Point on the north side of the harbor, or the tolling of the bell to the east and north, though all these signals were within easy hearing distance under normal conditions, and were actually heard at the time far beyond the ship at an elevated point. In other words, the sound waves were refracted upward and passed over the ship. The refraction of sound owing to the presence of air strata of different temperatures and densities is a well-known phenomenon, but in the case of a well-defined fog bank reflection appears also to play a part in causing the remarkable aberrations of sound that are so puzzling and dangerous to mariners.

Professor McAdie describes an instrument called the *fogometer* (a word, be it remarked, that the finical reviewer blushes to record as an addition to the English language), which enables the mariner to utilize simultaneously wireless and submarine or aerial signals in determining his position in a fog, when near a signal station.

The vessel, being equipped with wireless, asks the nearest signal station, also provided with wireless, to send signals simultaneously by the two methods at a time agreed upon, and to repeat the same at intervals of 10, 20 and 30 minutes. There will be a noticeable delay between the arrival of the etheric and the air or water signals. The transmission through the ether is practically instantaneous; the transmission through the water at average temperature is approximately 5,000 feet per second, and through air about one-fifth as fast as through water. Thus at each signal the distance of the ship from its signal station can easily be calculated. Given the bearing and speed of the ship, and her distance from a known point on shore at successive moments, the instrument in question affords an easy means of laying off her course on a chart.

Precautions to be Taken With Fuel Oil

FOR the benefit of those who use or contemplate the use of fuel oil on board ship, the United States Navy Department has issued an order which we here republish from the *Hydrographic Bulletin*. The instructions and precautions read as follows:

"Fuel oil as supplied to vessels of the navy is the residue of crude oil after the removal, by distillation, of sulphur and volatile oils and gases. It is inert, non-explosive, very difficult to ignite in bulk, and not capable of spontaneous combustion. The vapor from this oil is, however, explosive when mixed with the air, and, being heavier than air, tends to accumulate in low levels such as bilges and bottoms of tanks, where it may remain undiscovered until ignited by a naked light or spark. This vapor is always present in a partly filled oil tank, or in a tank which has contained fuel oil and from which the vapor has not been removed by artificial means, and is given off through the vents from tanks in process of being filled.

"A leak in any part of the oil-burning system may, if allowed to endure, result in an accumulation of this explosive vapor, unless the leak be located in the path of air to the furnace.

"Ignition of the vapor has been caused by an open light, electric spark, smoking, spark caused by striking metal, heat from the filament of a broken electric lamp, sparks from funnel, or has been communicated from the galley or the fires under boilers.

"An oil fire cannot be extinguished by water, but may be extinguished by sand, steam, or chemical fire extinguishers.

"An intelligent appreciation of the properties of fuel oil as described above is a better preventive of accident than adherence to any set of rules that may be prescribed.

"The following detailed precautions will, however, be rigidly enforced:

"1. When oil is being received on board, no naked light, smoking, or electrical apparatus liable to spark will be permitted within 50 feet of the oil hose, tank, compartment containing the tank, or the vent from the tank.

"2. While receiving fuel oil the storage tank must be closely watched for leaks, and care must be taken that all outlets from the tanks except the vents are closed.

"3. No naked light, smoking, or electrical apparatus liable to spark shall be permited at any time in a compartment containing a fuel oil tank. Electric lamps used in such compartments shall have wire protectors around the bulb, or shall be of a type that will insure the breaking of the circuit through the lamp in the case of breaking of the lamp.

"4. No one shall be allowed to enter a fuel-oil tank until it has been gas freed by the use of steam, and any person then entering the tank must have a life line around his body properly tended in order that he may be hauled out if overcome by gas.

"5. Smoking, electrical fuses and switches, unless of the inclosed type, shall not be permitted in compartments containing fuel-oil pumps or piping, except that smoking may be permitted on the fire-room floor plates in front of the furnaces.

"6. Care must be taken that the wire-gauze protectors in vent pipes from fuel-oil tanks are at all times intact, and smoking will be forbidden in the immediate vicinity of these vents.

"7. Dampers in the uptakes of boilers must be kept full open while burning oil. Otherwise there may result dangerous accumulation of gas in the furnace with a resultant backing out into the fireroom.

"8. The valves on glass gages on fuel-oil storage or settling tanks shall be kept habitually shut. When a reading of the gage is desired the valves may be opened, but must be at once shut again.

"9. In each fireroom fitted for oil burning there shall be fire extinguishing apparatus, consisting of:

"Steam fire hose, permanently coupled and of sufficient length to reach all parts of the fireroom, and either:

"(*a*) A box containing about two bushels of dry sand with a large scoop, or

"(*b*) Chemical fire extinguishers of the tank type.

"10. When the fuel-oil system has been not in use for a period of a week, or after joints in the piping have been remade, the system shall be tested cold, under pressures at least equal to the working pressures, before fires are lighted. During this test there shall be a careful inspection for leaks.

"11. Fuel oil will not habitually be heated above 150 deg. F., and never above its flash point in any part of the system except in the burners.

"12. Return connections from the burner-supply line permitting the recirculating of oil through the heater will not be permitted.

"13. Care must be taken to prevent the accumulation of oil or vapor in any place outside the system, particularly in bilges under the furnace. This can best be accomplished by rigid cleanliness.

"14. In the event of a considerable accumulation of oil in the furnace, such as may be caused by a sudden extinguishing of the burners, the vapor must be blown out through the smoke pipes by steam hose before fires are again lighted.

"15. For lighting the burners, a piece of burning waste on the end of an iron rod about four feet long is recommended. This is to protect the fireman from a back flash."

The "Hottest" Heat

NO feats of discovery present more points of fascinating interest than the attempts now being made by scientists to explore the extreme limits of temperature. We live in a very narrow zone in what may be called the great world of heat, a stretch of some 10,461 degrees. We exist in a narrow space, varying from 100 degrees above to about 50 degrees below zero, i. e., we are able to withstand these extremes of temperature. If a world catastrophe should raise the temperatures of our summers, or lower that of our winters, by a few degrees, human life would perish off the earth.

But though we live in such narrow limits, science has found ways of exploring the great heights of heat above us, and of reaching the depths below us, with the result that many important and interesting discoveries have been made. The results of the experiments in exploring the depths of cold are interesting and useful, but in the opinion of a writer in the *Yale Scientific Monthly*, they are not of as much practical value as are the experiments with the hottest heat.

At high temperatures, he states, heat vibrations are inconceivably rapid. "Nearly all substances known to man become liquids and gases. If the experimenter could go high enough, he could reach the high degree of heat of the burning sun itself, estimated at over 10,000 degrees. It is in the work of exploring these regions of great heat that such men as Moissan, Siemens, Faure and others have made such remarkable discoveries, reading temperatures as high as 7,000 degrees, twice the heat of boiling steel. Their accomplishments seem the more wonderful when we consider that a temperature of this degree burns up or vaporizes every known substance. How, then, could these men have made a furnace in which to produce this heat? Iron in such a heat would burn like paper. It seems inconceivable that even science would be able to produce a degree of heat capable of consuming the tools and everything else with which it is produced.

"The heat vibrations at 7,000 degrees are so intense that platinum, the most refractory and most unmelting of metals, melts like wax; the best fire brick is consumed like rosin. It works, in short, the most marvelous and incredible transformations in the substances of the earth. The earth was created in a condition of great heat, and a dying volcano gives only a faint evidence of the heat which once prevailed over all the earth. It was in the time of great heat that diamonds, sapphires and rubies were made.

"More wonderful, if possible, than the miracles wrought by such heat is the fact that men can now produce it artificially; and not only produce it, but confine it, direct it, and make it do their daily service. One has only to look at the power derived from Niagara Falls. At Niagara are the hottest furnaces in the world. Here clay is melted in vast quantities to form aluminium, a metal as precious a few years ago as gold. Here lime and carbon, the most infusible of all the elements, are joined by intense heat in the curious new and useful compound, calcium carbide. Here graphite, the cousin of the diamond, is made. Phosphorus is made in large quantities and carborundum is manufactured. It has been prophesied that it is merely a matter of time before diamonds will be made at Niagara.

"These marvelous new things in science and invention have been made possible by the 'chaining' of Niagara to the wheels of industry. The power of falling water is transformed into electricity. Science has found that the form of energy known as electricity can be changed into the vibration known as heat. Accordingly, thousands of horse-power are conveyed as electricity over a copper wire, changed into heat and light between the tips of carbon electrodes, and there work wonders. In principle, the electrical furnace is identical with the electric light. It is scarcely twenty years since the first electrical furnaces of practical utility were constructed, but if the furnaces to-day in operation at Niagara Falls alone were combined into one, they would, one scientist speculates, make a glow so bright that it could be seen from the moon. One furnace has been built in which an amount of heat energy equivalent to 700 horse-power is produced in an arc cavity not larger than an ordinary water tumbler.

"In the best modern blast-furnaces, in which the coal is supplied with special artificial means to make it burn the more fiercely, the heat may reach 3,000 degrees. This is less than half of that produced in the electrical furnace. In porcelain kilns, the potters, after hours of firing, have been able to produce a cumulative temperature of as much as 3,300 degrees; and this with the oxyhydrogen flame is the extreme of heat obtainable by any means except by the electrical furnace. Thus the electrical furnace has fully doubled the practical possibilities in the artificial production of heat.

"There are two kinds of electrical furnaces, just as there are two kinds of electric lights—arc and incandescent. Carborundum is made by the incandescent principle.

"The thermometer in use with the electrical furnace consists of a delicate thermometer registering say 3,000 degrees, which is set up some distance from the furnace.

"There can be no doubt that the possibilities of the electrical furnace are beyond all present conjecture. With American inventors busy in its future development, and with cheap electricity, there is no telling what new and wonderful products may be manufactured."

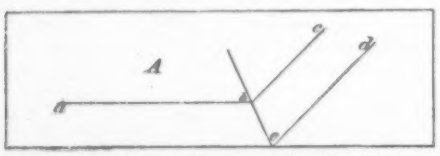
A Referendum

The Editor of Handy Man's Workshop is in a quandary. At his earnest solicitation, this department, which was formerly published but once a month, is now appearing every other week. But his colleagues are conspiring against him. They are trying to make him think that his department is far more interesting to him than to his readers. It may be that this is so, and if it be so, it is hardly fair for Handy Man to occupy two valuable pages of the Scientific American *every two weeks. But is it so? The Editor is not by any means convinced. He lays the question before his readers. Does Handy Man's Workshop interest you? Do you find it of real practical value? Do you wish it were conducted differently? Sit right down and tell the Editor all about it. Send him your suggestions. Tell him what you want, because, after all, the department is yours, and not his. If you have profited by the ideas of others, give others the benefit of your ideas. The Editor is always glad to receive useful workshop kinks, and pays promptly for such as are available. Address Handy Man,* Scientific American, New York.

Miter Box for Odd Angles

By W. D. Graves

WHILE a miter joint seems to be the only practicable one for many jobs, it is one of the weakest and most unstable jointures used in wood work. Wood is an unstable material, swelling or shrinking with every change of moisture conditions to which it is exposed, and no two pieces act just alike. For this reason pieces of it should be so joined that their change in size may make as little change as possible in the joint; but the slightest swelling will cause the miter joint to open on the outside, while shrinkage opens it on the inside. Hence, it is always best to use some other method of joining unless the material is thoroughly dry and will be well protected from changes of moisture conditions. Even



Layout for an obtuse-angled miter joint.

then its only excuse is its looks, but as the only reason for most moldings is ornamentation, and as the miter is the most practicable and comely method of joining them, it will continue to be used.

There are on the market many good devices for cutting miters which are far more durable and accurate than anything one can make for one's self, but the really good ones are apt to be rather expensive, for one who has but an occasional joint to make; and no wood worker will ever have reason to regret having learned how to make a miter box for himself. First select stock which is absolutely dry, preferably straight-grained, and of such available wood as is least affected by atmospheric conditions. The bottom should be thick enough to give ample strength and stability. The side of this which is intended to go uppermost should first be planed straight and true; and, using this as the "work side," the edges made square and parallel with each other. Next the side pieces are made true on what is intended for the inside, and the top edge of each is carefully squared with it. Having trued up and squared the side pieces as stated, gage down from the top edge of each to a distance which shall be the inside depth of the box; then nail or screw the sides to the bottom, using care to have the gage marks come exactly in line with the upper side thereof. Care should also be taken to so place the nails or screws that they will be well out of the way of the saw.

Set a bevel at the desired angle, with the blade projecting on both sides of the stock, and with a sharp knife point mark across the top edges, always working from the inside. With a steel square resting on the bottom, square up to each of these marks on the inside of the side pieces. Take the saw which is to be used in the box, being sure that it is in the best possible condition, and saw down carefully to these marks.

The stress laid upon the necessity for working from the inside is not intended to imply that the outside should be left rough; but, however nicely that is finished, dependence for accuracy should be solely upon the inside, for divided responsibility in mechanics, as in everything else, tends to trouble.

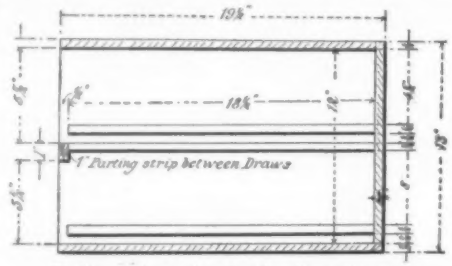
Though a miter, as the unqualified term is used among mechanics, is usually understood as the bisection of a right angle, it is not necessarily so; for pieces may be mitered at any angle. To set a bevel at the proper angle for a square miter, i. e., 45 degrees, place the stock against one side of a steel square, and swing the blade till its edge exactly coincides with corresponding graduations on the two blades thereof; that is, so that it shall be exactly the same distance from the corner on each side.

Of course, we all know how to bisect an angle geometrically, by the use of the dividers; but as it is handier to set a bevel by the edge of a board, and as it is somewhat difficult to handle dividers with the point on such an edge, it is better to get miters other than those of right angles in the manner illustrated in the accompanying sketch. Having carefully squared and jointed the edge of the piece of board, *A*, gage a line parallel with that edge and at any convenient distance therefrom, as *a*, *b*. Then, having set the bevel at the angle to be mitered, mark by it the lines *cb* and *de*, at the same distance apart as are the edge of the board and the line *ab*. If the blade of the bevel is now set to touch the points *e* and *b*, it will be at the proper angle for the desired miter. The miter for pieces of different widths may be thus obtained by making the distance between the edge of the board and the line *ab* equal to the width of one piece, while that between *de* and *be* equals the width of the other. In case the pieces are narrow, it may tend to accuracy to increase these distances, which may be done if care is taken to have them the same relatively to each other.

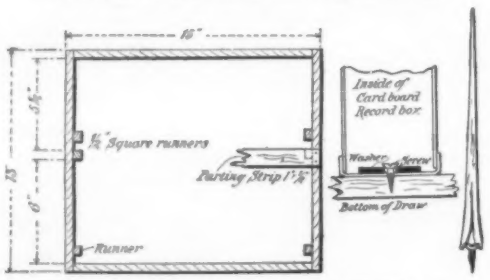
Case for Phonograph Records

By Ralph C. Davison

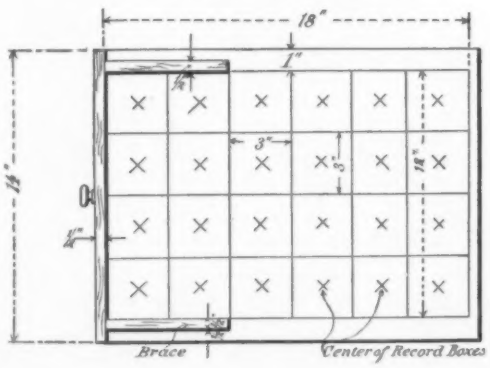
ALL those who own a phonograph know how fast the records accumulate and how necessary it is to provide a proper place for their safe keeping in order to avoid their being knocked over and becoming cracked or broken. The regular cases one can buy for the above purpose are expensive, but a cheap and useful one can be

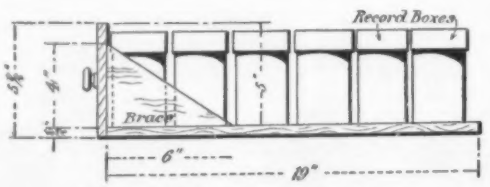


Sectional view, showing location of runners.



Front view of case with drawers removed.





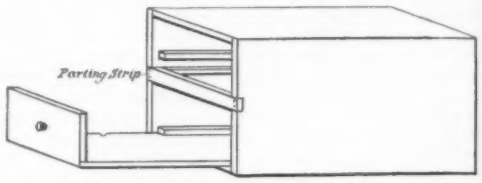
Plan and side views of the record case.

made at home by any one who is handy with tools by following the directions as given below.

Any kind of wood can be used. The writer made a very effective case of black walnut, using glass knobs as drawer pulls or handles. The case shown in the illustration has two drawers. Any number of drawers, however, can be provided, depending upon the number of records one has on hand or may be likely to accumulate.

The first thing to do is to make a box, the inside dimensions of which must correspond to the size of the outside dimensions of the drawers which it is decided to use. The box should be made of at least ½-inch material, and should be provided as shown with top and bottom runners for the drawers to slide between. The sizes of the drawers in the case shown are 14 inches × 18 inches. This provides room for 24 records. The drawer proper consists of a flat board with the front piece firmly attached as shown. Then instead of using pegs upon which to place the records, as is usual, the regular record boxes in whch they are bought are used. This the writer finds is a much better scheme than using pegs, as in removing the records from the pegs they are very apt to be scratched by one's finger nails, whereas in using the boxes there is no fear of injury from this cause, as the sides of the records are always completely protected by the flannel lining in the cardboard boxes.

To secure the boxes in their proper places first mark the location of their centers on the bottom of the drawers shown. Then with an awl make holes at each of the



The empty case with upper drawer removed.

centers thus marked, large enough to receive the points of the screws. The next thing to do is to punch a hole through the center of the bottom of each box, large enough for the screws to pass through easily. Now drop a washer down into the bottom of the box and center it over the hole. Owing to the small openings in the boxes one will find it hard to get the screws into the holes without using some special device.

The simplest way to get these screws into place, I found, was to take a thin piece of wood and to split it at one end, as shown in the illustration. By placing the head of the screw in this slot, as shown, they were held tight enough to allow of passing them through the hole in the bottom of the box and to give them a turn or two in the hole already made to receive them in the bottom of the drawer. The wood holder was then released from the screw and it was driven home with a long screwdriver, thus securing the box firmly in position. When complete this box made a most convenient and safe place in which to keep the records—especially convenient for the reason that the regular serial numbers of the records were discarded, and in their stead good sized numbers, cut from an old calendar, were pasted on the top of each of the record boxes. These numbers were placed in regular order, the first drawer containing numbers from 1 to 24 and the second drawer from 25 to 48. A list containing the names of the records, with their new numbers placed opposite to them, was then made out. In this way when a certain record is wanted, by referring to the list and getting its number, it can be picked out of the case in an instant, thus doing away with the annoyance of looking over a lot of record boxes before finding the desired record one wishes to play.

The material list for making the above case is as follows:

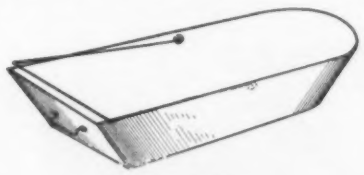
Pieces.	Size.	Location.
2	14" × 19½" × ½"	Top and Bottom.
2	13" × 19½" × ½"	Sides.
1	14" × 13" × ½"	Back.
1	15" × 1" × ½"	Strip Between Drawers.
6	18½" × ½" × ½"	Running Strips.
2	18" × 14" × ½"	Drawer Bottoms.
2	14" × 5½" × ½"	Drawer Fronts.
4	4" × 6"	Triangular Braces.
48	1½" dia.	Washers.
48	½"	Screws.
3	.....	Draw Pulls or Handles.

The Handy Man's Furnace Ashpan

By C. F. A. Siedhof

TO the man who takes care of his own furnace (and to his wife perhaps more so) the removal of the ashes with the accompanying dust, is a decided bugbear. As a result the ash removal is done as infrequently as possible, thereby endangering the grate, by allowing the ashes to accumulate in the ash-pit. If this same man will make, or have made, a pan to fit the ash-pit of his furnace, he will be surprised that he never had one before. I have had one made and in use for some time, and have not only overcome the dust nuisance, but have also saved much time in handling the ashes.

The pan was made a close, but by no means a tight fit, enabling it to be easily removed. The pan should be rounded at the inner end to conform to the shape of the ash-pit. If the pit within the ash door is circular, as is



The furnace ashpan.

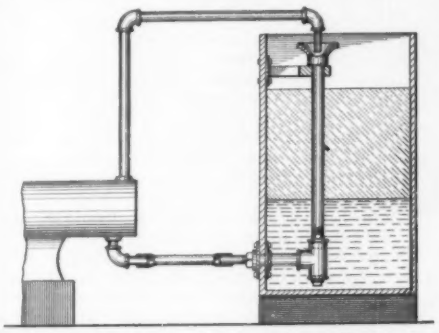
generally the case, it will be found that the few ashes that fall outside the pan will not interfere with taking the pan out and replacing it. These ashes need be removed only occasionally. The end of the pan toward the front of the furnace should be square across, and provided with a handle. A bail should be attached at the balancing point, so proportioned that when down, it will rest on the sides of the pan, and will not fall down into the ashes. Have the bail hinges of the kind to stop the bail from moving beyond the upright position. Remove and empty the pan before shaking down the furnace,

and avoid having to handle hot ashes. The sketch shows the general design for such a furnace ash-pan, which can, of course, be modified to meet individual needs. It is well to have the rear end made with considerable slant, as indicated, in order that it may fit as closely as possible against the back wall of the ash-pit.

Non-Freezing Connections for the Water-Jacket

By Jacob F. Kropp

THE accompanying engraving illustrates a method of connecting up the tank of a water-cooled engine, so that freezing of the water in the tank will not interfere with the circulation. Within the water tank a vertical pipe is mounted on a bracket. The upper end of this pipe is fitted with a flange, forming a sort of funnel mouth. At the lower end, the pipe is connected by a T-fitting to a cross-piece which passes through the side of the tank. Close to the T-fitting a ⅜-inch hole is drilled through the pipe. The projecting end of the cross-piece is connected by means of a rubber hose to the inlet end of the water jacket of the engine, while from the outlet a pipe is extended to a position directly above the funnel mouth of the pipe in the tank. In practice, when the tank freezes, even though the ice forms solidly to within a few inches of the bottom, there would be no interruption of the circulation, because the water is taken through the ⅜-inch hole. When disconnecting the tank, the flanged head of the vertical pipe is used as a handle to screw the pipe into the T-connection at the bottom, until the ⅜-inch hole is covered. Thereafter the rubber hose is removed, permitting the water in the vertical pipe to drain out. When starting the engine, it is merely necessary to connect up the hose, and when the engine warms up to pour some water into the vertical pipe, after which the pipe may be turned to uncover the ⅜-inch hole.

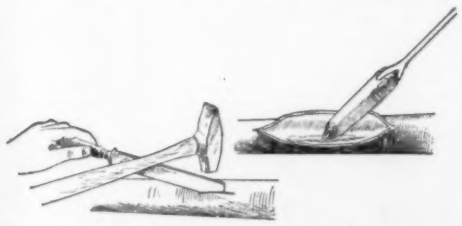


Non-freezing connection for the water-cooling system of an engine.

Repairing the Bottom Wall of a Lead Pipe

By Albert F. Bishop

IN case of a leak in the bottom wall of a horizontal lead pipe it is often better to repair than to renew the pipe. Cut a slit in the upper side with a thin knife and work the pipe open so that you can scrape the pipe bright and do your soldering on the inside. Use resin with the solder when soldering lead with a soldering copper. When the leak is sealed over with solder work back the lead on the upper wall, closing up the hole you have made with the knife and solder it. This wrinkle does not demand an expert workman. Indeed, it is doubtful whether an expert could solder underneath the pipe satisfactorily anyway.



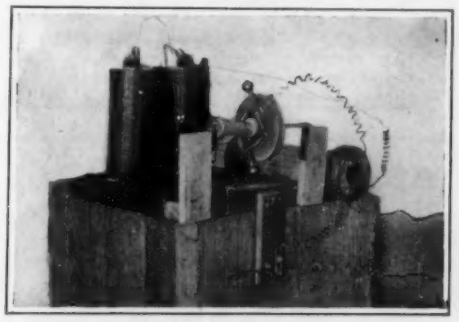
Repairing a leak from the inside.

An Automatic Cut-off for Electric Gas-lighting Circuit

By E. W. Williamsom, Jr.

IT is probable that everyone whose dwelling is fitted with electric gas lighting, has been annoyed at one time or another by the premature exhaustion of the batteries, through an accidental ground or short circuit, due to chafing of the wires or to abuse of the burners by ignorant servants. Having been annoyed by this trouble several times lately, I have worked out a device which automatically opens the battery circuit within five seconds of the formation of a ground or short circuit, such as would run the batteries down. It was necessary that the regular use of the system should not be interfered with, the mechanism becoming active only on a short circuit.

The photograph, Fig. 1, clearly shows the appearance of the device, and the drawing, Fig. 2, the details and circuits. The cut-off was made as follows: A base board about 7 inches square, of ⅞ stuff was obtained, and at one end of this were nailed two wooden uprights, 3 inches long. To these were screwed 1-inch strips of thin brass, ¼-inch wide, the ends projecting ½ inch above the wood, and a 1/32-inch hole was drilled in each projecting end to form bearings for the spindle. This was a 5-inch length of 3/16-inch round brass rod, each end being drilled centrally to receive a piece of thin wire nail, to fit loosely in the bearings and reduce friction. A grooved pulley, 2½ inches in diameter and ⅜ of an inch thick, was turned from soft wood, as was a spool 2 inches long and ⅓ inch in diameter, with a ⅝-inch flange at each end, the right-hand flange being ⅓ inch wide. The spool was drilled lengthwise with a 3/16-inch hole, and reamed out with a rat-tail file, so as to revolve loosely on the spindle.



Automatic cut-off for electric gas-lighting circuits.

A clutch was now fitted to the face of the pulley, consisting of two arms of 3/16-inch square brass rod, 2 inches long.

At one end was soldered a ½-inch brass ball, and the other end was filed out in a curve to correspond with the circumference of the broad flange of the spool. The arms were then drilled through at a point ¾ of an inch from the lower end, and screwed to the pulley face, with a washer beneath, and loose enough to swing freely, pins being driven into the wood at each side to limit the movement. A light rubber band was stretched from each arm to the pin, to pull them away from the spool when at rest. The spool was then slipped on the spindle, the pulley driven on with a tight fit, and the whole mounted in the bearings.

A dollar electric motor, with a three-pole armature, was now screwed to the base about 4 inches back of the pulley, and belted to the latter with a loop of shoe thread, waxed.

A piece of shoe thread about 3 feet long was then tied tightly around the spool and hung vertically, terminating in a ⅛-ounce lead weight. Between the wooden uprights, a 4-inch wooden strip, 1½ inch wide, was nailed to the base, pointing downward, and on this was pivoted a contact arm, with a wire ring at the outer end, through which the weighted thread was passed. As the motor would not run on the regular battery circuit, when in series with the spark coil, the iron core of the latter was used as a magnet, to attract a small iron armature fastened to a strip of the very thin spring brass, screwed at one end to the wooden end of the coil, and having at the other a bit of platinum foil. On the coil head was fixed a short piece of platinum wire, and the contact of these closed a local circuit of two cells, to run the motor. Rather delicate adjustment was required with these contacts.

The connections were made thus: The lever switch on the lower strip was cut in, in series, between the spark coil and the battery.

The spring contact on the end of the coil was put in series between the local cells and the motor. The operation is as follows: When a pull burner is operated, the core of the coil will attract the armature, closing the local circuit for a moment, but not long enough to work the clutch. A ground, however, closes the local circuit and holds it so; the motor speeds up, causing the arms of the clutch to close on the spool by centrifugal force. The latter then turns with the pulley and winds up the cord and weight, the latter finally tripping the ring on the switch and opening the main circuit. The cut-off should be set at sufficient elevation to allow of a drop of three feet for the weight, and will then open the switch in five seconds. A good way is to suspend it from the joists of the cellar, as the coil and batteries are often hung thus. The dimensions given are not necessarily to be followed, but may be varied to suit the convenience of the constructor. The operation of an automatic does not start the machine at all, owing to the rapidly broken contacts.

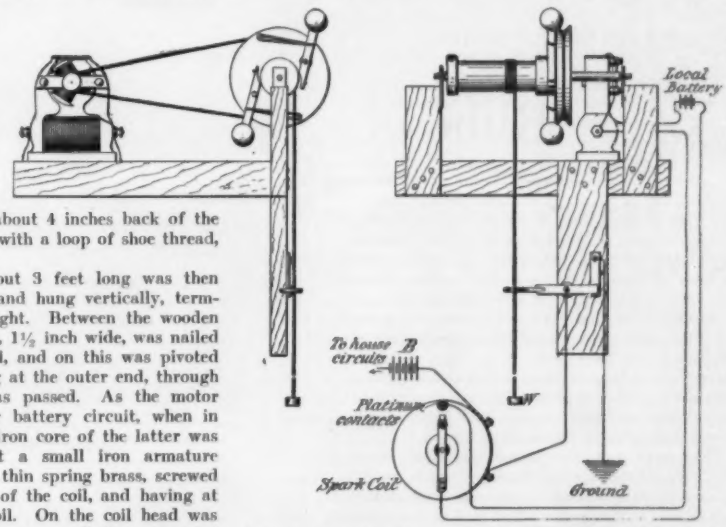


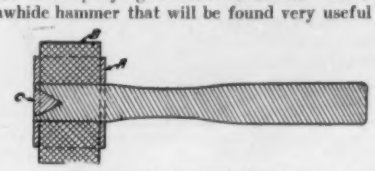
Fig. 2.—Construction and wiring diagram of the cut-off.

Rawhide Hammer

By H. M. Nichols

THE accompanying sketch shows the details of a rawhide hammer that will be found very useful around a shop for driving arbors in place, and for numerous other jobs, where it is essential that the work be driven tightly in place without being battered or marred.

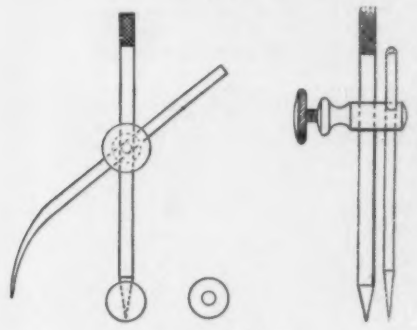
This hammer can be made in any size, depending on the class of work it is intended to be used for. First get a piece of steam pipe *A* of the proper diameter, and drive the rawhide *B* into it, allowing it to stick up from a half to three-quarters of an inch above the pipe. Then drill a hole through the center of the pipe and rawhide, and file it to fit the handle. After driving the handle in, fasten it in place with a small iron wedge, *C*.



Home-made rawhide hammer.

Cone Center Dividers

THE accompanying drawings show a handy pair of dividers, which will be found useful for scribing accurate lines around existing holes or centers. This tool consists of the clamping sleeve and needle of a regular surface gage, and a hardened center box having a 60-degree cone center at the lower end. The center bar is made of drill rod just the size of the surface gage bar, so that the sleeve will fit on. When the holes to be used as centers are larger, a 5/16-inch ball is used. The ball has a 60-degree center made in one side as shown. The ball is magnetized, so that when placed in position it will not fall off. This tool has been found extremely handy for all-around work.



Cone center dividers.

How to Caliper Over a Flange

A HANDY little kink is pictured in the line cut, showing how to caliper over a flange when there are no blocks available for building out far enough for the calipers to clear the flanges. With a small prick punch make a mark in each leg of the caliper, and when the calipers have been set over the flange to get the size of the rib, as shown in the sketch, a pair of dividers are set carefully in the punch marks. The calipers are then removed over the flanges and reset, using the dividers again, when the size of the rib may be determined by scaling the calipers.

Calipering over a flange.

A Novel Compass for Aeroplanes

The Needle Points Out the Direction of Travel

THE accompanying illustration shows an ingenious compass which has just been invented by Mr. A. G. Marquis, of Rochester, N. Y. This compass differs from all those of the ordinary type in that the needle appears to move and point to the direction in which the boat or aeroplane is traveling. This is a very great advantage for inexperienced aviators, for instead of having to figure out the direction they are traveling from the indication of the compass needle and the chart, they can tell at a glance which way their machines are headed.

The compass consists of a needle mounted in the regulation way so that it can swing and direct itself to the North. Surrounding the compass needle in the same horizontal plane is the chart having the points of the compass marked upon it. This chart is reversed, however, as to North and South, and the needle is arranged so that it points to the South also. The result is that the reflection in the mirror placed at the angle of 45 degrees above the chart is correct, the North point appearing at the top and the South point appearing at the bottom of this mirror.

Let us suppose the aeroplane to be headed toward the North; the compass needle will be pointing North on the reflection of the chart as seen in the mirror. If the aeroplane is now steered toward the East, instead of the needle's remaining stationary and the charts moving around beneath it so that Northwest and then West appears below its point, the needle will apparently swing around to the Northeast and East and will continuously indicate the direction in which the aeroplane is traveling. The apparent movement of the pointer is the result of an optical illusion, for the pointer actually remains stationary and the chart turns in the regular way. One is apt to be puzzled, at first, to explain just why the needle appears to move, but at all events it does so and indicates accurately the course being followed at every moment

On the rear of the instrument there is a place arranged for a lamp, the rays of light from which are reflected upward through the dial and thrown upon the mirror in case it is desired to use the instrument at night. The gear of one of the smaller experimental models is illustrated as well as the front view of the large model.

An experimental Marquis compass with the needle in alcohol to deaden the vibrations was recently tried by William Hilliard, the aviator, at Mineola, L. I., and the results obtained were satisfactory with the exception that a heavier fluid than alcohol was found to be required in order to deaden properly the vibrations of the needle. It was found necessary to place the instrument some eight feet in advance of the engine in order that the magneto should not affect it. There have been a number of novel compasses devised of late for aviators, but the one herewith illustrated seems by far the most practical and ingenious of them all.

Two models of Marquis's compass, showing rear and front respectively.

An interesting fact in connection with the South-pointing needle was unearthed by the inventor in looking through the books in the Reynolds Library at Rochester. This was found in an extract from the writings of Humboldt. It referred to the use of a South-pointing compass by the Chinese in the year 2600 B. C.—a use not for water, but for land navigation. In the forward part of a wagon or chariot there was placed a freely floating lodestone which moved the arm and hand of a small figure and caused it to point constantly toward the South. Kleproth, whose researches upon this subject have been confirmed by Blot, Stanillus, and Julian, found an old tradition from which he believes that this magnetic wagon was in use in the reign of the Emperor Honngti, who is believed to have lived at about 2600 B. C. Magnetic wagons were, however, used as late as the fifteenth century, and several of these were preserved in the Chinese Imperial Palace and were employed in the building of Buddhist monasteries for fixing the points towards which the main sides of the building were directed. The inventor of this new aeronautical compass has apparently, therefore, hit upon the oldest form of compass, and by improving and bringing it up to modern requirements, he has changed it from a compass for directing land courses to one for indicating the path of air craft.

Ruhmer's Recent Work in Wireless Telegraphy

Some New Methods of Transmitting Speech Without Wires

By Dr. Alfred Gradenwitz

SHORTLY after Marconi's first experiments in wireless telegraphy, a system of wireless telephony based on similar principles was suggested by several experimenters. The aerial of the transmitting station was to give out electrical waves corresponding to the sound vibrations, and these were to be absorbed by the receiving aerial in order to be reconverted into sound waves. While the arrangement of the receiver did not offer any unsurmountable difficulty, nearly ten years were required to perfect a suitable transmitter.

The most primitive scheme obviously would consist of utilizing, directly, the fluctuations in current intensity produced by speaking against the membrane of a microphone for exciting the aerial of the transmitting station. On account, however, of the low frequency of sound vibrations, this method had to be discarded from the very beginning, it being suggested to transform the microphone currents to a high tension utilized in feeding a spark-gap which in its turn would generate the rapid vibrations required for exciting the antenna. This scheme did not lead to any practical results either, as the upper harmonics, characteristic of vowels and consonants, were found not to set up any spark discharges. Moreover, the amount of energy converted into electromagnetic waves by means of ordinary microphones did not allow of any wireless communication to a considerable distance.

The necessity of generating by means of a special source of energy, electrical vibrations acted upon by the microphone currents was thus realized. However, this idea could not be carried out into practice before a process for generating continuous (nondamped) electrical vibrations had been designed.

It is well known that this aim a few years ago was attained in wireless telegraphy by two different methods.

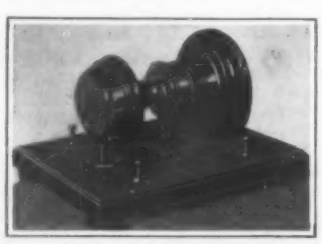
In connection with one of these methods, based upon Tesla's experiments, vibrations are generated by a high-frequency alternate current dynamo. The most successful experiments in this direction have been made in America by Fessenden with a machine operated by a steam turbine, which with 16,000 revolutions per minute produced about one kilowatt alternate current of 100,000 cycles per second.

The other method is based upon Duddell's "singing arc." If a capacity and self-induction be connected up in parallel to a direct-current arc passing between homogeneous carbons, this, under certain conditions, gives out a sound corresponding to the characteristic electrical vibration of the vibratory circuit. This sound is only a secondary phenomenon attending the production of alternating current in the vibratory circuits. While the energy thus converted into vibrations, and especially their frequency, are too low for the purpose at issue, both factors are increased considerably by placing the arc in an atmosphere of high heat conductivity, such as hydrogen or lighting gas, as first suggested by Poulsen.

A "singing arc" improved in this manner really allows alternate currents to be generated with an energy and frequency sufficing for the purposes of wireless telegraphy and telephony. It will be readily understood that the designation "singing arc" then becomes a misnomer, the human ear being incapable of perceiving the acoustic effects of an arc traversed by several hundred thousands of vibrations per second.

The detector used in connection with this system of wireless telephony is a minute thermo-element consisting of two conductors as widely separated as possible in the series of thermo-electric tensions, which on the passage of very feeble vibrations generates an undulating direct current perceived by means of a sensitive galvanometer or telephone.

As regards, next, the application of the above principle to the purposes of wireless telephony, the vibrations generated in the antenna of the transmitting station can be influenced by sound waves in two different ways, according as either the intensity or the frequency is altered. Only the first alternative has so far been carried out in actual practice. Ernst Ruhmer, of Berlin, the well-known experimenter and physicist, some years ago commenced some experiments in connection with which the current feeding the generator of the "singing arc" was acted upon by sound waves. The dynamo used in this connection possessed a frequency identical with that of the natural period of the antenna. As the current intensity in the antenna depends on its resistance, the electric waves given out from the latter are bound to undergo variations corresponding to the intensity of the original sound waves. In connection with the arrangement represented in the diagram, the microphone is connected up in parallel to the coils coupling the antenna to the vibratory circuit. Another arrangement suggested by the same experimenter comprises a double microphone, one compartment of which is arranged in the antenna and the other in parallel to the coupling coils of the latter.



Relay for operating calling bell.

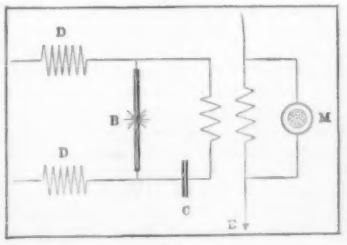
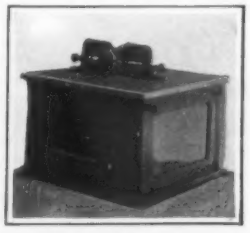
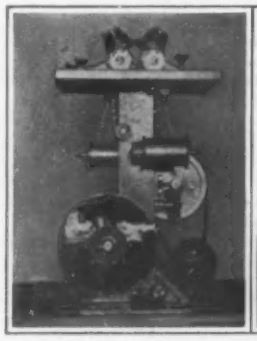


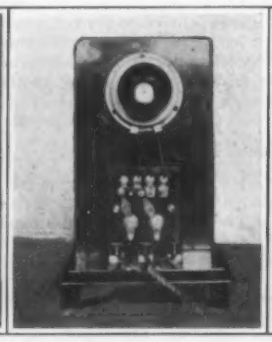
Diagram of connections.



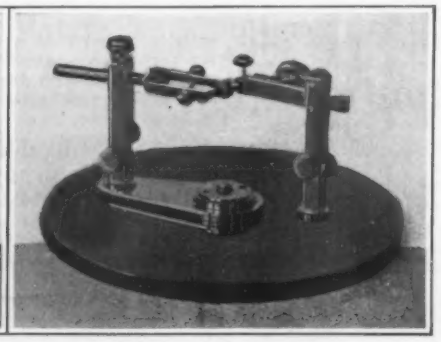
Old type of generator.



The latest generator.



Double microphone.



Detector used by Ruhmer.

RUHMER'S RECENT WORK IN WIRELESS TELEGRAPHY

Ruhmer's further work in

(Continued on page 235.)

The Inventor's Department

Simple Patent Law; Patent Office News;
Inventions New and Interesting

Picking Cotton by Machine

By William Day

THE greatest obstacle in the development of Southern agriculture has been the necessity of utilizing hand labor in gathering the cotton crop. A large portion of the negro population, men, women and children, are employed during the harvesting season picking open bolls by hand. This necessitates a very great needless expense to the planter for producing his crop, and it is attended by a large percentage of waste, since the negroes frequently pluck unripe bolls which must be thrown away as useless.

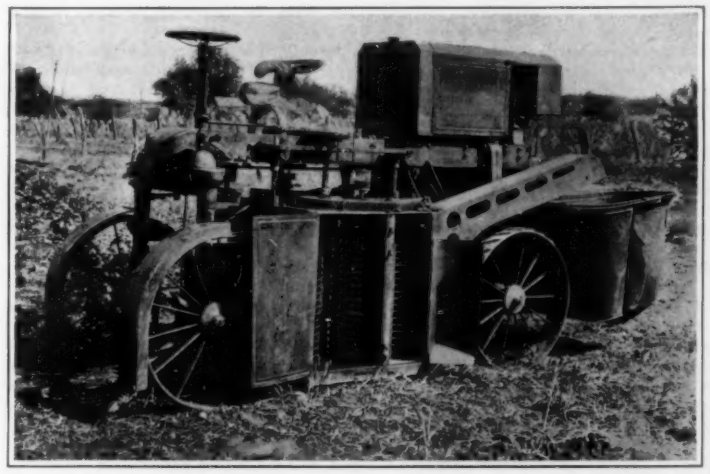
Remembering that the Southern cotton crop supplies a very large proportion of the raw material for European mills in addition to the bulk of raw material for American textile industries, any plan which will reduce the cost of cultivation and harvesting is of great importance. The inventor has had his attention turned to this for a number of years, and various devices have been patented and constructed to take the place of hand labor in picking the cotton. Until recently, however, all have been unsuccessful.

Mechanism has at last been invented which appears to solve the problem of harvesting cotton by machinery, as the harvester operated by steam, gasoline and horse power performs the work on the wheat farms of the West, one of them doing the work of a hundred or more human laborers. There is an important difference between picking cotton and harvesting the grain. The grain harvester goes over the field cutting down every stalk. The cotton machine is so adjusted that it picks only the bolls that are ripe or fit for harvesting and leaves those which are not matured. In one field a month or more may elapse before all of the plants are ready for picking, and for this reason it is necessary to cover the ground at least twice by the machine, which operates so rapidly and is so efficient that the percentage of ripe cotton left after the machine has done its work is so small as to be insignificant, as compared with the great waste which results from careless picking by the negroes. The machine picks about 10 pounds of seed cotton per minute, or 6,000 pounds per day of 10 hours, if kept running continuously, or 5,400 pounds per day, allowing 10 per cent for stoppage. The quantity picked varies somewhat, depending on the amount of ripe cotton on the plants, but the above amount may be considered as a fair average. On the first trip it gathers 90 per cent of the ripe cotton, and the remaining 10 per cent is picked on the second trip.

An average of thirty horse-power is required to operate this interesting cotton picker. A gasoline motor of 30 horsepower is usually installed for the service. Beneath the engine are what are termed two picking attachments swung under it, and a pair of canvas bags hung out behind. It moves over the field as fast as a man walks, the wheels passing along the spaces between the rows of plants. The cotton is picked over by the revolving steel fingers which catch the lint but leave the plant uninjured, so that later bolls may mature. The picking machinery is on two drums which hang from the frame of the tractor.

An endless chain of upright cylinders of small diameter follow each other around the drum. From these cylinders the needles or spindles which do the picking project horizontally into the plant. In operation each part has its individual movement. The drum carries the cylinders around; the cylinders force the needles into the plant at the proper angle, to twist and catch the cotton.

Every motion is delicately adjusted. While the needles move fast enough to catch the fiber, their speed is not fast enough to throw it out of the receiver. The cylinders bring each needle into place at the proper time, so that there is never a space large enough for an open boll to pass through without being stripped of its contents. The drum is moving backward at the same rate that the whole machine moves forward, so that the picking needles do not move horizontally through the plant, but merely turn in it. In the cylinders of each picker are no less than 816 of the steel fingers which harvest the cotton. But one man is required to operate the engine, while he also steers the mechanism. A boy may be employed to sit in the rear to see that the cotton is all deposited through the conveyor into the storage bins, but unless the bolls are thick on the stalk, all of the cotton is stored mechanically.



The latest type of cotton picker, with casing opened to show the mechanism.

The modern cotton picker in operation.

This cotton picker moves between rows, so that the pickers play upon the bolls.

THE NEW COTTON PICKING MACHINE

Tests have been made of the new cotton picker in several different States, while it is being operated extensively in the Texas fields. These tests of capacity and thoroughness were carried out by experts of the Agricultural Department, as well as the farmers themselves who are operating it, as contrasted with hand labor.

The pickers do not engage the imperfectly developed cotton of diseased bolls, but they frequently pick the flocculent cotton from one side of an open boll but have not force enough to pull out that clotted or glued in imperfectly developed lobes. This is one of the most important features of the cotton picker.

As to the cost of operation, the maximum expense does not exceed five dollars a day, including the wages of the man and boy, and a gallon of gasoline consumed every hour for a day of ten hours. This is the average outlay as shown by calculations made in Texas and other portions of the South. As a result of this investigation it has been calculated that it gathers ninety-five per cent of the open cotton, actually picking from 550 to 900 pounds per hour, according to the amount of cotton on the stalks and the rate at which run. This is more than the original estimate. Except for a few green leaves, the cotton is as clean as, if not cleaner than, that hand picked.

This remarkable invention may be called the life work of Angus Campbell, a Scotch inventor, who for many years has lived in Texas and has made a study of plans to economize the gathering of cotton by portable machinery. Mr. Campbell has worked on his plans for over twenty years, and made over fifty-five designs. In every case, however, with the exception of the present model, some defect has been found in operation which prevented the cotton picker from being of practical use. Enough of the latest type, however, are now in operation to show beyond question that the present model is remarkably efficient and that it has many advantages over the old hand picking method not only in reducing the expense, but in lessening the time of harvesting a field and in performing other operations, while it is so constructed that it is extremely durable and can be operated for an indefinite time.

This method of harvesting the cotton has naturally interested the textile manufacturers, especially the experts of New England cotton mills. The question has naturally arisen to what extent if any the cotton fiber has been broken or otherwise injured by being pulled out by the needles instead of fingers. Examinations have been made of cloth in the various stages of manufacture at the Wamsutta as well as several other mills. A bale of hand picked and a bale of machine picked were passed through this textile plant and the conditions were fully studied. When the cotton reached the mill it was decided by the experts that the machine picked cotton was slightly higher in grade than the hand picked cotton. The cotton in both cases was then passed through from the raw state to the woven cloth. In the picking, carding and other departments, the percentage of waste was the same to a fraction, frequently. In the spinning there was no greater breakage in the machine picked than in the hand picked. The machines were operated, the rollers set and the twist was the same in both instances. The breaking strength of the yarn

showed a fraction stronger, one or two pounds stronger, in the machine picked staple. The fiber used was 1-inch to 1 1/16-inch cotton spun in twenties. It broke at a pull of one or two pounds more than the hand picked cotton presented. In examining the yarn it was found to be equal in quality to the hand picked staple. After the yarn was spun it was woven, and an examination showed no difference whatever in the appearance of the cloth in any respect. After it was woven it was bleached, and in the finished state the machine picked cotton again showed slightly better than the hand picked. The cotton was also subjected to a microscopical test to see if any fracture of the fiber could be discovered. None whatever was discovered.

The Pan-American Union and the Inventor

JOHN BARRETT, the Director-General of the Pan-American Union, which is the new name of the Bureau of American Republics at Washington, is responsible for the Pan-American Commercial Congress which was in session during the week of February 13th, at the Pan-American Union. Mr. Barrett's idea is that since the opening of the Panama Canal will tend to change the commercial complexion of the entire western hemisphere, it is not too early for the twenty-one American republics who constitute the Pan-American Union to come together for the purpose of considering in practical and friendly manner, what the conditions and prospects are for the extension of commerce between these nations.

Accordingly this preliminary conference was called, and in order that its official character should not be open to the slightest doubt, Mr. Barrett invited the President of the United States to make the address at the opening session, to sound a note of welcome and co-operation. An innovation which succeeded in pleasing everyone was the determination, which was rigidly carried out, that in place of a long program of subjects and speakers, allowing no participation by the delegates and experts, sessions were open and led by specially designated authorities and continued by the others present.

The Monday or opening session was of a more formal character and was addressed, in addition to the President, by Secretary of State Knox; Hon. Joaquin B. Calvo, Minister of Costa Rica; Hon. Ignacio Calderon, Minister of Bolivia; Hon. Joaquin D. Casus, former Ambassador of Mexico; Senator Root, Representative Champ Clark, and President James A. Farrell, of the U. S. Steel Corporation. All introductions were made by Director-General Barrett. On the same evening Dr. Albert Hale, of the Pan-American Union, gave an illustrated lecture and travel talk on Latin America.

On the four succeeding days of the conference, a long list of speakers took part. On Friday, the Commissioner of Patents, Mr. Edward B. Moore, was to have addressed the conference briefly on the purpose and scope of the three conventions regarding trade-marks, patents and copyrights, which he succeeded in having adopted by the Buenos Aires Congress in the summer of 1910. Mr. Moore, however, was ill and was unable to speak on this very important subject.

This Pan-American Commercial Conference being wholly preliminary, there was no thought of formulating by its means any definite plans with regard to the acceleration of trade-relations or exchange of commerce, as it was termed. The purpose was to get as far as possible the attitude of each nation, through its duly credited representative; and while the matter was not thoroughly exhausted, a good general idea has been gained as to the position of each nation. No results can be counted on, of course, at this time. There will be other Commercial Conferences, and at each one it is expected the Pan-American nations will get closer and closer together upon the subject of interchange of commerce—a subject which is so vital to the life of each country as a nation.

The aid given by the United States in the promulgation of the three Buenos Aires conventions is fully acknowledged. The manufacturer and the inventor in each subscribing nation can rest assured that in exporting his goods into the other subscribing countries he will be no longer forced to compete with infringing articles. Trade-marks will be respected; patents will be upheld, and copyrights will carry the same value in foreign nations that they do in their own. It is particularly on account of these matters that the eyes of American commerce are turned upon Mr. Barrett's Commercial Conference. When the report is published, there will be no doubt a wide demand for it from the leading commercial houses of the countries. That the merchants and manufacturers took a large interest in the proceedings is amply proven by the presence of representatives from all over the United States. Boards of Trade, Chambers of Commerce, Bankers' Associations, Manufacturers' Associations and Tariff Leagues, were all represented. From coast to coast, representatives were found in attendance, and the coming together of these leaders of trade from widely separated points will doubtless bring about a most helpful fusion of ideas and an eventual accomplishment of real good.

Mr. Barrett should be congratulated upon his untiring efforts. The Pan-American Union is fundamentally an international organization devoted to the development and maintenance of commerce, friendly intercourse and good understanding between the nations supporting it. Its affairs are administered by Director-General Barrett and the Assistant Director, Mr. Francisco J. Yanes, who are elected by and responsible to a governing board composed of the Secretary of State of the United States and the diplomatic representatives in Washington of the other American governments. Its executive officers are assisted by a staff of international experts, statisticians, commercial specialists, editors, translators, compilers, librarians and clerks. The Union conducts a large and varied correspondence covering every phase of Pan-American relations; it publishes a monthly bulletin, which is a record of Pan-American progress. Mr. Barrett has made this publication an encyclopedia of information regarding a part of the world that was, until the Pan-American Union was established, but little known outside of the lower part of the western hemisphere. In the building of the Union, is an up-to-date library of 20,000 volumes relating to American subjects, geographical, historical and commercial. The new million dollar home of the Union is part of the parkway system of Greater Washington and overlooks the broad Potomac, which at this point is more than half a mile wide. It stands at the foot of Seventeenth street and its new neighbors are the beautiful Corcoran Art Gallery and the Memorial Hall of the Daughters of the American Revolution.

A Convention on Copyrights

A COPY of a convention concerning literary and artistic copyright, signed on August 11th, 1910, by the delegates of the United States and of the other countries represented at the Fourth International Congress of American States, has been sent by the President of the United States to the Senate. The provisions of the convention are the following:

First. The signatory States acknowledge and protect the rights of literary and artistic property in conformity with the stipulations of the present convention.

Second. In the expression "literary and artistic works" are included books, writings, pamphlets of all kinds, whatever may be the subject of which they treat, and whatever the number of their pages; dramatic or dramatico-musical works; choreographic and musical compositions, with or without words; drawings, paintings, sculpture, engravings; photographic works; astronomical or geographical globes; plans, sketches or plaster works relating to geography, geology or topography, architecture or any other science; and, finally, all productions that can be published by any means of impression or reproduction.

Third. The acknowledgment of a copyright obtained in one State, in conformity with its laws, shall produce its effects of full right, in all the other states, without the necessity of complying with any other formality, provided always there shall appear in the work a statement that indicates the reservation of the property right.

Fourth. The copyright of a literary or artistic work, includes for its author or assigns the exclusive power of disposing of the same, of publishing, assigning, translating, or authorizing its translation and reproducing it in any form whether wholly or in part.

Fifth. The author of a protected work, except in case of proof to the contrary, shall be considered the person whose name or well known *nom de plume* is indicated therein; consequently suit brought by such author or his representative against counterfeiters or violators, shall be admitted by the courts of the signatory states.

Sixth. The authors or their assigns, citizens or domiciled foreigners, shall enjoy in the signatory countries the rights that the respective laws accord, without those rights being allowed to exceed the term of protection granted in the country of origin.

For works comprising several volumes that are not published simultaneously, as well as for bulletins, or parts, or periodical publications, the term of the copyright will commence to run, with respect to each volume, bulletin, part or periodical publication, from the respective date of its publication.

Seventh. The country of origin of a work will be deemed that of its first publication in America, and if it shall have appeared simultaneously in several of the signatory countries, that which fixes the shortest period of protection.

Eighth. A work which was not originally copyrighted shall not be entitled to copyright in subsequent editions.

Ninth. Authorized translations shall be protected in the same manner as original works.

Translators of works concerning which no right of guaranteed property exists, or the guaranteed copyright of which may have been extinguished, may obtain for their translations the rights of property set forth in article 3, but they shall not prevent the publication of other translations of the same work.

Tenth. Addresses or discourses delivered or read before deliberative assemblies, courts of justice, or at public meetings, may be printed in the daily press without the necessity of any authorization, with due regard, however, to the provisions of the domestic legislation of each nation.

Eleventh. Literary, scientific, or artistic writings, whatever may be their subjects, published in newspapers or magazines, in any one of the countries of the Union, shall not be reproduced in the other countries without the consent of the authors. With the exception of the works mentioned, any article in a newspaper may be reprinted by others, if it has not been expressly prohibited, but in every case the source from which it is taken must be cited.

News and miscellaneous items published merely for general information do not enjoy protection under this convention.

Twelfth. The reproduction of extracts from literary or artistic publications for the purpose of instruction or chrestomathy, does not confer any right of property, and may therefore be freely made in all the signatory countries.

Thirteenth. The indirect appropriation of unauthorized parts of a literary or artistic work, having no original character, shall be deemed an illicit reproduction, in so far as it effects civil liability.

The reproduction in any form of an entire work, or of the greater part thereof, accompanied by notes or commentaries under the pretext of literary criticism or amplification, or supplement to the original work, shall also be considered illicit.

Fourteenth. Every publication infringing a copyright may be confiscated in the signatory countries in which the original work had the right to be legally protected, without prejudice to the indemnities or penalties which the counterfeiters may have incurred according to the laws of the country in which the fraud may have been committed.

Fifteenth. Each of the governments of the signatory countries shall retain the right to permit, inspect, or prohibit the circulation, representation, or exhibition of works or productions concerning which the proper authority may have to exercise that right.

Sixteenth. The present convention shall become operative between the signatory states which ratify it three months after they shall have communicated their ratification to the Argentine government, and it shall remain in force among them until a year after the date when it may be denounced. This denunciation shall be addressed to the Argentine government and shall be without force except with respect to the country making it.

Patent Office Decisions on Appeal

IN the decisions on appeals from the Commissioner of Patents handed down by the Court of Appeals of the District of Columbia, on February 7th, the decisions of the Commissioner were sustained in six out of eleven cases. Mr. Chief Justice Shepherd pronounced three opinions reversing the Commissioner in two cases out of three; Mr. Justice Van Orsdel affirmed the Commissioner in all three cases in which he rendered the opinion of the Court, and Mr. Justice Robb reversed the Commissioner's holdings in three out of five cases in which he delivered the opinions.

Notes for Inventors.

Heany Indicted for Perjury.——In 1908 John Allen Heany, inventor of York, Pa., Henry E. Everding, his attorney, of Philadelphia, Pa., and Ned W. Barton, an assistant examiner in the Patent Office, were indicted and tried for conspiracy to destroy, steal and forge certain papers belonging to applications for patent for the tungsten incandescent lamp and for processes for producing same, filed in the Patent Office by Heany, through Everding, and for stealing, destroying and forging those papers. Barton confessed and was sentenced to three years in the penitentiary; Everding was convicted and sentenced to two years in the penitentiary, and Heany was acquitted. Proceedings were instituted in the Patent Office, subsequently, by the Commissioner to determine what disposition should be made of the applications involved, filed by Heany, and whether valid patents can be granted upon them in any event. Investigation has been in progress for some time and testimony has been taken in the Patent Office. During the investigation the fact developed that John Allen Heany is believed to have perjured himself before the Grand Jury, which investigated the original charges, and that he had been guilty of suborning witnesses to testify falsely in support of his claims. These facts were reported by the Commissioner of Patents to the District Attorney, who brought the matter before the Grand Jury at the present term, and the Grand Jury on February 24th, 1911, found indictments against John Allen Heany for perjury and for subornation of perjury.

Patents and Trusts.—Many times the value of a patent is established by the strength of the promoter. An attorney tells of a patent, now expired, for a simple article. It was limited, necessarily so, because of what had been done before. Some years after the issue of the patent, a large concern, some would call it a trust, realizing that a market could be created for the article and an outlet afforded at the same time for a waste product, secured the rights under the patent on a royalty of about one cent a thousand. As the articles were made by the barrel, it amounted on an average to $750 per quarter, or $3,000 per year. The trust in order to warrant its creating the demand, needed patent protection and was of such financial strength, that any weakness in the patent was not material, as it was able to put up a strong fight. When last seen, the patentee told of the patent having expired, and when the attorney deplored the loss of royalty said: "Not at all, I'll make more money out of it now than ever." In the meantime he had developed a fine plant with a waste product of his own, was able to make the article cheaper than the trust, and is now reaping the benefits of the market created by another under the protecting influence of the patent.

Another Selden Patent.—George B. Selden, whose patent, No. 549,160, has been the subject of much important litigation in connection with the automobile industry, was appellant in a case decided by the United States Court of Appeals for the District of Columbia early in February. The case is known as patent appeal 667, and its subject was an application for patent filed by Mr. Selden September 7th, 1895, as a division of a prior application filed May 8th, 1879, the parent application of May 8th, 1879, having matured into patent dated November 5th, 1895, No. 549,160, which is the celebrated "Selden patent." The division was required by the Patent Office, and during the prosecution of the divisional application it was held abandoned for lack of sufficient prosecution within the statutory period. The Court of Appeals in a decision handed down by Mr. Justice Robb reversed the decision of the Commissioner of Patents, held that the application was not abandoned, and directed that it be reinstated, so that another Selden patent on an application divided out of the original Selden application filed May 8th, 1879, more than thirty years ago, may be expected.

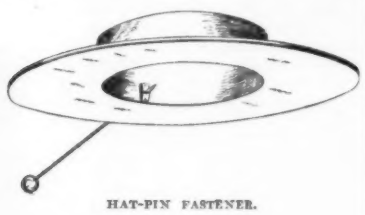
RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

Pertaining to Apparel.

HAT PIN FASTENER.—ROBERT L. RAYNOR, McKeesport, Pa. The invention is pictured in the engraving herewith and is a new form of fastener or spring clasp adapted for attachment to the crown of a hat and to receive and hold a hat pin so that it forms practically a permanent attachment of a hat. Means provide that the side of the hat is not pierced

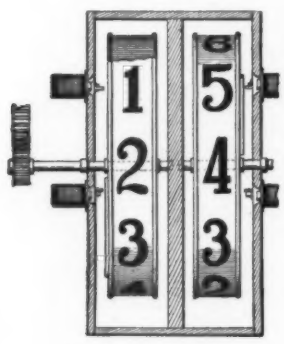


HAT-PIN FASTENER.

and injured or worn out by continued piercing of the pin as when no clasp is employed. The size of the opening in the clasp relative to the pin allows the latter considerable freedom of adjustment so that the pin may hang at an angle to the hat crown, which avoids leverage and strain on the latter.

Electrical Devices.

INDICATING DEVICE.—CLARK N. WISNER, Memphis, Tenn. The invention relates to devices for use in indicating stock quotations. An object in the improvement shown herewith is to provide a device which may be manipulated by an operator at a central station so as to display visible signs for indicating values and locations, thereby dispensing with the



INDICATING DEVICE.

necessity of the customary ticker now used in most brokers' offices. A plurality of these devices may be run from one key set made by connecting certain magnets having similar positions with the same key, thereby bringing the same indicating numeral before the opening when the key is depressed.

MOTOR CONTROL APPARATUS.—D. WALD, O. C. BRITSCH, and M. TAIGMAN, New York, N. Y. An object here is to provide an apparatus for controlling electric motors, which can be used for various purposes, though particularly useful in connection with motor-driven sewing machines or the like, which can be operated by means of a pedal, and which, when the pedal or the corresponding part is released, automatically stops the motor.

Of Interest to Farmers.

MANURE SPREADER AND LOADER.—C. F. WAY, Elm Creek, Neb. The object of this invention in manure spreaders and loaders is to provide a simple and efficient device which may be easily operated, easily transported from place to place, and which will lift a large load with a small amount of power.

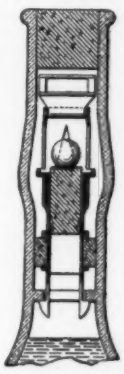
Of General Interest.

REVETMENT MATTRESS.—C. C. CONDIE, Memphis, Tenn. It is sought in this invention to provide a mattress of novel construction and including a filling of excelsior impregnated with a cementitious substance which will form a concrete when placed in water and will bind in connection with the excelsior filling and form practically a solid mass.

STAGE APPARATUS.—J. A. VAN SANT, San Diego, Cal. An object in this case is to provide scenery frames in sections, each section being pivoted, there being means by which the several sections may be turned on their pivots simultaneously. Another object is to provide stage properties with means by which they may be supported in the sections.

MOLD AND METHOD OF MAKING THE SAME.—J. D. BROWN, Suffern, N. Y. The invention provides a mold especially adapted for casting brake shoes provided with metal backs previously prepared for the purpose and, by the molding operation, merged into and made integral with the shoes. It further relates to special provision for holding, within the mold, the metallic back or other member to be thus united with, and merged into the casting.

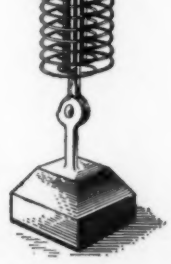
NON-REFILLABLE BOTTLE.—WILLIAM H. SPELLMON and SAMUEL BUSER, Haledon, N. J. The object of the invention pictured in the engraving, is to provide a convenient, strong, and durable non-refillable bottle inexpensive to manufacture, which permits fluid to be freely poured from the bottles but renders the introduction of fluid through the neck extremely difficult, which cannot be filled by inverting the bottle in a body of fluid, as the valve member will float into a closed position, and which is so constructed that the valve will tend to close even when the neck of the bottle is arranged in a horizontal or slightly downwardly inclined position.



NON-REFILLABLE BOTTLE.

SYRINGE.—J. H. SHEETS, New York, N. Y. This invention relates to syringes of the barrel and piston type, such as in Letters Patent of the U. S., formerly granted to Mr. Sheets. The aim of the present invention is to provide a syringe composed of comparatively few parts, and arranged to form a container for safely carrying a large quantity of liquid, to be ejected periodically in small doses as required.

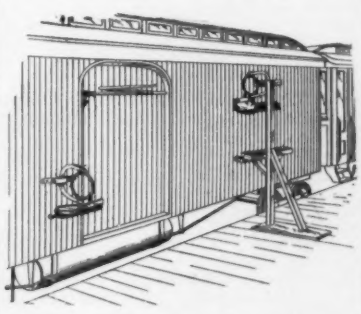
PEN AND PENCIL HOLDER.—ADDISON B. MARSHEL, 3219 Strong Avenue, Kansas City, Mo. This invention relates to a holder of a type adapted to act, if desired, as a paper weight. The object of the invention illustrated herewith is to provide a pen and pencil holder which can be extended up into a convenient



PEN AND PENCIL HOLDER.

projecting position, when in use, and folded down into a small compass, when not in use. A very simple and efficient device is provided, whereby pens or pencils may be supported in a readily accessible position, even though the device is located on a book or a desk piled with papers.

MAIL POUCH TRANSFERRING APPARATUS.—RAY S. SCOFIELD, Clarkston, Wash. The invention illustrated herewith provides a

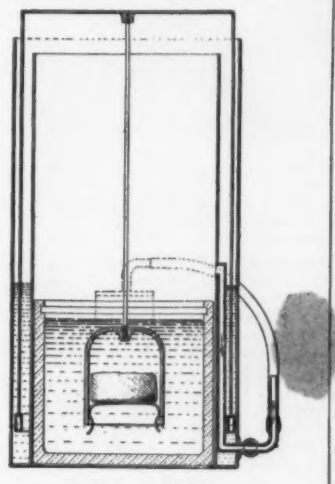


MAIL POUCH TRANSFERRING APPARATUS.

yoke pivoted to a crane and a hook mounted on a car, the yoke being provided with means for holding it yieldingly in the direction of the tracks on which the car travels. The yoke is also provided with spring clasps for holding in place a ring to which a mail pouch may be secured. The hook, which is provided for engaging the ring, has a spring for preventing the escape of the ring after it has been caught. The hook is secured to a pivoted rod, yielding means being provided for holding the rod extended and against rotation.

HORSESHOE AND CALK THEREFOR.—J. W. MILLER, Red Wing, Minn. The purpose here is to provide calks for the heels and toe of a horseshoe, having novel form; and further to provide means for attaching the calks to the shoe in a manner that will permit the calks to be readily removed when worn out, and be replaced by others that are new or have been repaired, so as to be capable of renewed service.

OXYGEN GENERATOR.—RICHARD C. BRADLEY, Shreveport, La. The invention in this instance is illustrated by the accompanying engraving, and its object is to provide a portable generator which will automatically generate gas as fast as it is consumed, and in proportion to consumption of the gas. A further object is to provide a device which can be used as a cartridge for generating the gas or with an auxiliary device for generating the gas by means of heat. The generation of gas is automatically regulated by merely turning the stop cock off or on.

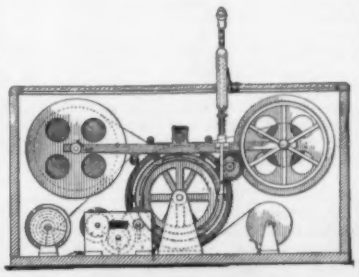


OXYGEN GENERATOR.

Machines and Mechanical Devices.

RELEASING MECHANISM FOR BOATS.—F. ERIKSEN, 3 Taffelbays Allé, Copenhagen, Denmark. The releasing hooks in this instance relate to that class in which the boat is suspended from the tackle blocks by fore and aft hooks which are linked together and adapted to act simultaneously to release the boat or raft as soon as it is water borne owing to the pressure ceasing on said hooks and allowing them to turn.

REGISTER FOR WEIGHING SCALES.—GARNETT J. DYE, Montgomery, Ala. Among the principle objects which the invention pictured by the engraving has in view are: To provide a registering mechanism attached to the beam of a scale for producing a permanent and transient record indicative of the operation on the scale; to provide inking means for the said mechanism and for the permanent record thereof, and to provide corrective means



REGISTER FOR WEIGHING SCALES.

for the register with the sale beam, flexible in character, to accommodate the irregular movements of the beam. Between the loading of each individual car, if desired, the machinery of the registry may be changed so that the successive cars are registered from an initial loading point.

CAR FENDER.—J. P. GERAGHTY, Jersey City, N. J. The object of the present invention is the provision of a new and improved car fender, arranged to insure the safe picking up of a person or other obstruction in the path of the fender and without danger of maiming or otherwise injuring the person or other obstruction.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

AMERICAN MEN OF SCIENCE. A Biographical Directory. Edited by J. McKeen Cattell, New York: The Science Press, 1910.

The last decade witnessed a remarkable change in the scientific activities of this country, which to those familiar with conditions in our institutions of learning must seem truly marvelous. Several of the leading universities have created chairs devoted entirely to research, while nearly every university worthy of the name now seeks to fill its chairs with men who are able to carry on investigations as well as to give instruction. Another important factor which has so largely contributed to this scientific activity is the establishment and princely endowments of institutions such as the Rockefeller Institute, the Carnegie Institution, the Institute of Infectious Diseases, and, last but not least, the Bureau of Standards and the Philippine Bureau of Science, both of which are government institutions. This period has also witnessed the birth of several scientific organizations, as well as the expansion and improvement of the older ones. Scientific periodicals have also increased in number, and some of them quite appreciably in size.

This renaissance of science in America, although a matter of comment among the scientific workers themselves, seems to be but little known to the great lay public, which is apparently indifferent to science and scientific men unless a sensational feature is associated with a discovery. This probably accounts for the failure of "American Men of Science," now in its second edition, to excite any comment or even attract notice in most of our great periodicals of New York, Chicago, and other large cities. It would undoubtedly be a surprise to many a lay reader to learn that this country, so widely famed for its practical view of life and its utilitarianism, should possess several thousand men devoted to scientific investigation, not a very remunerative occupation, as many of its devotees will testify.

To Prof. James McKeen Cattell, the well-known psychologist and editor of several scientific periodicals, belongs the credit of having undertaken and accomplished a work which many of his class would undoubtedly consider a thankless task. The book contains the names of over four thousand men who have contributed to science by research, teaching, compilation, or administrative work. All the exact and natural sciences are covered, including the applied sciences, such as Engineering and Medicine. A few Economists, Sociologists, and Educators, however, are also included. Each sketch contains the time and place of birth, education, subject of researches published and investigations in progress. The object of Prof. Cattell, however, was not simply a compilation of records of thousands of individuals as regards the time and place of birth, education, and activity in their chosen field of work. The book is not merely a "Who is Who" in science, interesting though this is, especially to the scientific workers, who ought to be acquainted with one another. Its aim is much higher. As the author tells us in the preface, it is intended that it should be a contribution to the organization of science in America, and forcefully points out in the appendix our ignorance of the conditions underlying scientific progress. Thus he contends that it is not known definitely whether or not the present methods intended to advance science, such as prizes, pensions, freedom, or obedience and discipline, reputation, title, etc., advance or retard scientific productivity. He further calls attention to our ignorance of the "kind of education methods of work, and modes of life which are most favorable to scientific productivity." Prof. Cattell made a study of a thousand investigators whose contributions are considered the most important by the ten leading men of each science. It may be of interest to observe that the judges were selected by Prof. Cattell. That the validity of the method of ascertaining the leaders of each science is questionable, is perfectly obvious to any scientific worker familiar with the men and their work in his own line. Of the 175 chemists whose work is regarded as most important, the writer knows of at least six who made no contribution of any consequence. All these men can claim is the publication of a few chemical analyses of doubtful commercial value. This is also true of some teachers of physiology and pathology who occupied chairs in medical schools but published little of any value. On the other hand, some men who made solid contributions to science by research and the best kind of teaching failed to receive recognition. The omissions are perhaps of little consequence; but to give prominence to men absolutely without scientific merit—and Prof. Cattell can easily convince himself of the truth of this statement if he desires—is a reproach to scientific men of real merit and is certain to defeat the very purpose for which this study has been undertaken, namely, to stimulate the progress of science. That the method adopted by Dr. Cattell led him into serious error is likewise shown by the places accorded to some scientific institutions. We are informed, for example, that Columbia University stands second in zoology. Will any student of zoology agree with such a statement in view of the magnificent work done by every member of this department of Columbia University? The severe criticism of the Depart-

ment of Agriculture is likewise entirely unjustified. The real reason why the Department is losing some of its best men is due to the increased demand for investigators in our universities, and to the fact that the college presidents have learned that such men are available in some of the bureaus in Washington.

DAS SYSTEM DER BIOLOGIE IN FORSCHUNG UND LEHRE. By Dr. Phil. S. Tschulok. Verlag von Gustav Fischer in Jena. 1910.

There is much to be said in favor of a historical-critical book on biology. It has the merit of reconstructing the various stages of a scientific conception. This process of reconstructing a concept according to what Windelband called an "ideographic" method gives a kind of biological ancestral gallery, and drives home the necessity of correctly estimating the reason why the ideas of each period assumed the particular form that they did and no other because they could logically assume no other. After the history of a concept has been traced, the critical question arises, "What is the scientific value of the concept at the present day and how far does it meet modern requirements?" It is this manner of treatment that Dr. Tschulok has adopted for his book, and it must be confessed that the result has been a very lucid presentation of modern biology which is a good deal more than a history and a good deal more than a critique. His work falls naturally into three parts. In the first, he shows how the problems and the system of botany and zoology was conceived at various times, and how these conceptions may be construed in the light of contemporary scientific thought. In the second part, the question is considered, "How is the particular problem to be considered from our modern standpoint, and how is the problem to be solved?" This, without any regard whatever for historical considerations. In the third part, we find a comparative estimate of the past and the present. In other words, we have a combination of the first two parts of the book in so far as the author shows how far the present view departs from the correct view, because it is influenced by tradition. The traditional element originated from the older phases of the evolution of the concept discussed. The author, therefore, discusses not the historical necessary of these traditional elements, but the logical justification of their continued existence in the light of modern research. In selecting the authors for the historical section of his book, the author frankly admits that he was governed entirely by personal considerations. He was concerned merely with presenting type pictures which answer his purpose, and not a complete series of biographies which would trace the evolution of individual views.

THE AGE OF MAMMALS. By Prof. Henry Fairfield Osborn. New York: The Macmillan Company, 1910. 635 pp.; 220 illustrations. Price, $4.50 net.

Prof. Henry Fairfield Osborn is the foremost authority in this country, and probably in the world, on the subject of vertebrate paleontology. Under his able guidance, the American Museum of Natural History houses probably the finest collection of prehistoric animals ever gathered under one roof. A work from so distinguished an authority is, therefore, bound to be welcomed. It would be difficult indeed to imagine a work which would do more to spread the knowledge of paleontology among English-speaking peoples than this, for here is brought together a mass of information which has never before been published. A work such as this should aid the specialist in describing his new species, for there can be no doubt that a painstaking examination of previous types aids much in determining new varieties and species. Although the book is not light reading, it follows out Huxley's plan of scattering scientific truth for the benefit of those who are willing to do a little serious thinking. As Prof. Osborn tells us in his preface: "Time and place are the main theme of this work rather than descent, which has been the main theme of all previous general treatises on the Caenozoic mammals; it is a study of the sources or birthplaces of the several kinds of mammals, of their competitions, migrations, and extinctions, and of the times and places of the occurrence of these great events in the world's history. To set forth this history in all its grandeur, it is interesting to consider the question of past environments, such as the past geography (palæogeography) of the earth, the changes in climate and in the earth's surface which conditioned the evolution of plant life (paleobotany) as the primary source of food supply for the mammals. This geology, geography, botany, and climate are treated as leading to a clear understanding of each of the successive groups and movements of mammalian life."

A TEXT-BOOK OF GENERAL BACTERIOLOGY. By Edwin O. Jordan, Ph.D. Second revised edition, 8vo.; 594 pp.; illustrated. Philadelphia and London: W. B. Saunders Company, 1910. Cloth, $3 net.

The book is profusely and well illustrated, and, since externals strike the eye first, it is perhaps not out of place in reviewing the book to praise at the outset its general arrangement and technical excellence. The care which has been bestowed on these matters is but the outward symbol of an inner worth which is evidenced both in the manner of treatment and in the material presented.

After an introductory chapter the author considers in order the technique of bacteriology, the structure, development, and composition of bacteria, the effect of physical and chemical agents upon them, and conversely the effects produced by bacterial growths upon their environment. A short chapter on the classification of bacteria may be said to conclude the first part of the book, dealing with the general facts of bacteriology. The chapters which follow, VII to XXX, deal specifically with bacteria and protozoa pathogenic in man. The remaining chapters deal with those aspects of bacteriology which are of economical rather than medical interest. They include a consideration of the bacteria of milk; the bacteriology of the "nitrogen cycle" in agriculture, and in the economy of the living world; arts and industries depending on the action or exclusion of bacterial agents, such as the manufacture of leather, the curing of tobacco, the preservation of foods, etc. There is a chapter on the bacteria of air, soil, and water, and finally one on bacterial diseases of plants. An appendix is devoted to the consideration of infectious diseases of unknown causation.

The statement on page 60 that Brownian movement is due to surface tension is hardly in keeping with recent developments of physics and of the Kinetic theory, in which this peculiar phenomenon has found a most interesting place. To the bacteriologist this may not be a point of much importance, yet in view of the very considerable physical significance attached to the matter, and in the interest of scientific accuracy, the statement should be modified in later editions of this very excellent work.

FARM DEVELOPMENT. By Willet M. Hays, Assistant Secretary United States Department of Agriculture. London: Kegan Paul, Trench, Trübner & Co., Ltd. New York: Orange Judd Company, 1910. Pp. xii + 391. 281 illustrations.

A notable contribution to the literature of agriculture in its more practical aspects has recently been issued under the title of "Farm Development," by the Assistant Secretary of Agriculture, Willet M. Hays. From his long and wide experience as a teacher and investigator in the college and school of agriculture of the University of Minnesota and as administrative officer in the U. S. Department of Agriculture, Secretary Hays has prepared a most instructive discussion on soils, selecting and planning of farms, subduing fields, drainage, roads, and fences, introducing the whole with chapters dealing with the relations of general science to agriculture and with farming as a vocation.

The book is written from the standpoint and especially for the benefit of those who come from farm homes and expect to return to the country to live, i. e., the viewpoint of the average farmer. The effort is made to adapt the text to the agricultural high school, the consolidated rural and village school, and the needs of the farmer's home library. The book tells just how to select and lay out a farm; to arrange the buildings for comfort, convenience, and beauty; to plan the fields and prepare them by levelling, clearing of stumps, rocks, etc., and drainage (and in dry regions by irrigation) for easy and successful culture; and to construct farm roads, bridges, and fences. In the treatment of the latter subjects, usually classed as rural engineering, the engineer's point of view is subordinated to that of the practical farmer, i. e., the agricultural rather than the engineering side is emphasized.

In the chapter on farming as a vocation Prof. Hays sets forth the attractive features of farming as a business and the importance to the State of a strong, contented, prosperous race of farmers. He says: "Farming is, on the whole, a conservative line of business, though often subject to severe variations in the profit it affords. In farming, few men become millionaires, and few paupers. It is not a line of the greatest financial opportunities nor of the greatest misfortunes. Its money rewards average less than those of any of the average city vocations, but including with things money will buy, those things money will not purchase, or for which cash is not needed, farming furnishes as much, or more, on the average, of remuneration as does effort applied in the average of other vocations. In conducting the family-sized farm, the minor portion of the remuneration comes in the form of money, while good food, clothing, a beautiful home, wholesome outdoor employment, independence, and other useful and enjoyable features of rural life constitute the larger portion."

And further: "The home is the most influential institution in our national life, and the farm home is the best place to produce strong and useful citizens. The farm home is racially our most important home. Farmers are rather conservative and are peculiarly loyal to the good of the community. Their voice usually rings true for sound and good government, though they are sometimes slow to embrace improvements in governmental affairs. The nation needs to retain men and women on our rich lands who are so trained as citizens, as well as farmers, as to be capable of maintaining our country life at a high standard. It is interested in the farmer's prosperity, because the general well-being of the rural community insures for the future a strong race of people, and prosperity among the producing classes insures prosperity to all classes and to the nation."

He also points out that the study of science as applied to agriculture is not only useful but intensely interesting, lifts farm work out of the drudgery into which it is often allowed to fall, and is rapidly raising farming in the scale of vocations.

HOW IT FLIES. By Richard Ferris, B.S., C.E. New York: Thomas Nelson & Sons, 1910. 475 pp.; 150 illustrations. Price, $1.20 net.

In this popularly written book, Mr. Ferris has given rather a good explanation, for the benefit of the man in the street, of the leading principles underlying the construction of aeroplanes and airships. In arrangement, his book differs not radically from the dozens of popular books which have been issued in the last year. There is the usual account of the atmosphere, the principles underlying flying machines, a description of the biplane and the monoplane, as well as a brief history of flight, the construction, operation and manufacture of balloons, dirigible and otherwise, a glossary, etc. So rapidly has the art of flying developed that some of the types which Mr. Ferris illustrates are now old. Thus, the old Voisin machine is illustrated, and not the new, although the new is mentioned. The old Antoinette machine, with ailerons, is illustrated and described instead of the newer machine with warping wings. Likewise the old model of the R. E. P. monoplane is selected for description instead of the new type.

HOW TO KNOW ARCHITECTURE. The Human Elements in the Evolution of Styles. By Frank E. Wallis, A.A.I.A. New York: Harper & Brothers, 1910. 8vo.; 327 pp. Price, $2 net.

Architecture and building are covered in this book as two branches of one subject. The object of the author can be plainly put thus: "After you have read this book you can, on looking at a building, say to what style and what period it belongs." Also, this is the first book on architecture to be illustrated by American models chosen by the author. The style of the book is direct and concise.

THE ELEMENTS. By Sir William A. Tilden. London and New York: Harper & Brothers, 1910. Pp. xi + 139.

Sir William Tilden has given us a brief and clear exposition of the ideas which eventually developed into a periodic law, and of the reconsideration of many problems of a new physical science which has been brought about by the discovery of the radio-active elements. Theories such as these must be fought for; for they mean a revolution in scientific thought. Sir William presents his views boldly, despite the knowledge, which must be his, that most chemists are against him. He has done his work well, however; better, indeed, than any chemist whom we can think of at the moment. He has expressed with remarkable definiteness concepts that have hitherto been very hazily expressed even by the men who have been the staunchest adherents of the modern theories of matter. The book comes to us at a time when chemistry is in a transition stage, at a time when we must reform our ideas of the nature and origin of the elements. We need just some such book as this to help us in shaping anew our ideas of the relationship of the elements, a relationship which is suggested by the periodic table of Mendeleff.

THE BOYS' BOOK OF MODEL AEROPLANES. How to Build and Fly Them. With the Story of the Evolution of the Flying Machine. By Francis A. Collins. New York: The Century Company, 1911. Price, $1.20 net.

It is not surprising that at the present time, when the subject of aviation is so much in the public eye, that the boys should wish for a share in this fascinating science. A remarkable statement was made not long ago by an army officer that the boys of America had already spent more money in experimenting on aviation than had the government. This is undoubtedly correct for wireless telegraphy as well as aviation. The number of aerial wires on the flat houses of New York is something astonishing. The various meets to fly model aeroplanes which have been held in New York alone have attracted widespread attention. The present book gives a succinct account of the methods of building model aeroplanes of all descriptions. The book is handsomely printed, the illustrations being printed on coated paper. This book will open a new world to boys.

THE BIG GAME OF AFRICA. By Richard Tjadler. New York: D. Appleton & Company, 1910. 8vo.; 364 pp. Price, $3 net.

Good books on hunting trips and adventures in the "Dark Continent" are plentiful. The author's apology for offering to the public "The Big Game of Africa" is a desire to comply with the wishes of his many friends who have heard his lectures on Africa, and have repeatedly asked him to issue them in book form. The volume is not only a narrative of his own wanderings and experiences in that continent, but is also intended to be a guide book for those who are thinking of hunting in Africa, and also for those who are expecting to stalk game with camera or gun. The book is made up of the experiences of three expeditions in British East Africa, and contains the most reliable information that it is possible to obtain from others who have hunted in that wonderful game country, and from the natives who themselves spend most of their time wandering among the big game of Africa. The book is beautifully bound and is an addition to any library.

HEIDE UND MOOR. Von Dr. Adolf Koelsch. Stuttgart: Gesellschaft der Naturfreunde, 1910.

Dr. Koelsch is one of the most respected, and likewise one of the best known popular scientific writers of Germany. In the volume which lies before us, an excellent example of the good printing and good writing which has made the little monographs issued by the Kosmos Gesellschaft of Stuttgart a pleasure to handle and to read, he has given us a simply worded and attractive account of the scientific marvels of heath and moor.

THE "PRACTICAL ENGINEER" POCKET BOOK AND DIARY FOR 1911. London: Technical Publishing Company. New York: Van Nostrand.

This pocket book is so well known to all engineers that there is hardly any need to comment upon it. A number of additions have been made to bring the contents up to date. The printing is not everywhere as good as might be desired.

MAGICIANS' TRICKS. How They Are Done. By Henry Hatton and Adrian Plate. New York: The Century Company, 1910. 8vo.; 344 pp. Price, $1.60 net.

Most books of this kind consist of a collection of time-worn illusions whose workings have been exposed over and over again. While the old, basic principles are of necessity to be found in this treatise, there are also many things that will be new, at least in their combinations and mode of presentation, to most of our amateur conjurers. Card, coin, and egg tricks are dealt with at some length, and there are sections on spiritualistic ties, mind reading, and the more elaborate stage illusions. Formulas for making flash paper, conjurer's wax, and other preparations are appended. The illustration is profuse, the description commendably clear.

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS. Compiled and arranged by H. Winfield Secor. New York: Modern Electrics Publication, 1910. 16mo.; 100 pp.; 72 illustrations. Price, 25 cents.

In addition to expounding coil theory and construction, interrupters, vibrators, and transformers, considerable space is devoted to the Tesla coil, and instructions are given for making a large coil of this type, suitable for lecture-platform demonstration.

AS THE GODS DECREE. A Novel of the Time of Augustus. By Daniel Henry Morris. New York: Broadway Publishing Company, 1910. 8vo.; 361 pp. Price, $1.50.

In giving us a very readable story of old Rome, the author is to be commended for dispensing with the usual element of Christian persecution and martyrdom. Two themes—the love of a father for his motherless daughter, and the constancy of a Greek concubine toward her lord—stand out in relief from a background of gladiatorial combat, intrigue, and foreign campaign. The topography of the ancient city and the life of its people are faithfully presented, and the more important characters are strongly conceived. The plot is rather transparent, but the attention of the reader is held throughout by the briskness of the action.

THE FOREST AND THE SAW MILL. Chicago: National Lumber Manufacturers' Association, 1910. 8vo.; 269 pp. Price, 50 cents.

The eighth annual convention of the National Lumber Manufacturers' Association was held in April, 1910, at New Orleans. This is the official report of the convention, and is dedicated to those who are seeking practical means of forest conservation. Among the papers read before the assembly, and here given in full, are "The Problems of Private Forestry"; "The Lumber Production of the United States"; and a symposium of trade relations and conditions under such headings as "The Coastwise Trade"; "Waste of Natural Resources"; and "Insurance and Price Problems." It is hard to find a phase of the subject which is not ably presented. Freight classification, forest fire protection, the common interests of banks and lumbermen—all are carefully discussed by men thoroughly conversant with facts and conditions.

ART-CRAFTS LAMPS. How to Make Them. By John D. Adams. Chicago: Popular Mechanics Company, 1911. 12mo.; 87 pp.; 16 designs. Price, 25 cents.

The aim of this handbook is to enable anyone to construct from paper, cardboard, and wood, with the aid of a sharp knife and a little paint and glue, really artistic lamps for the hall, the den, the porch, and the dining-room. The designs run from simple portable lamps to four-light chandeliers.

THE AUTOMOBILE. Its Selection, Care, and Use. By Robert Sloss. New York: Outing Publishing Company, 1910. 194 pp. Price, $1.25.

A very good little book, that should prove valuable not only to intending purchasers of a machine, but also to those who already possess one.

INQUIRY COLUMN

Inquiry No. 9218.—Wanted, the names and addresses of manufacturers of outfits for salting almonds and peanuts.

Inquiry No. 9223.—Wanted, to buy machinery for making sugar of milk.

Inquiry No. 9224.—Wanted, to buy a machine for making flat-sided popcorn cakes.

Inquiry No. 9225.—Wanted, to buy a motor driven floor scrubbing machine.

Inquiry No. 9226.—Wanted, a concern able to grind and polish hammers.

Inquiry No. 9227.—Wanted, a power-driven saw for cutting down pine trees twenty inches in diameter.

Inquiry No. 9228.—Wanted, to buy fabric tufting machines.

Inquiry No. 9229.—Wanted, addresses of manufacturers of an alloy called Duraluminum.

Inquiry No. 9231.—Wanted, addresses of owners of water falls having a four-foot fall and upwards.

Inquiry No. 9232.—Wanted, addresses of manufacturers of engines that can be run with crude oil.

Inquiry No. 9233.—Wanted, a roller or other device for skinning a beef in rapid, economical manner.

Inquiry No. 9234.—Wanted a small specialty of universal salability to sell from $3 to $10. Proper articles can be financed.

Inquiry No. 9235.—Wanted, names and addresses of manufacturers of machinery and appliances for making celluloid.

Inquiry No. 9236.—Wanted, the name and address of the firm making the New England Filling Machine.

Inquiry No. 9237.—Wanted, information relative to the Parmelee Automatic Aerated Water Still and Steriliser.

Ruhmer's Recent Work in Wireless Telegraphy

(*Continued from page 230.*)

wireless telephony was mainly in the direction of the design of a suitable generator of higher constancy and which would be able to give out a greater energy of vibration. This is based on Ruhmer's arc interrupter, viz., an electric arc connected up in series to a substantial blowing electro-magnet and in parallel to a vibratory circuit. In opposition to Duddell's arrangement, the vibratory circuit here is positively excited by the rhythmically working blower that interrupts the electric arc. This method allows practically any amount of energy to be converted into vibrations.

In order to insure a sufficient frequency of interruption, two methods can be resorted to. On one hand Poulsen's scheme of cooling the electrodes and the arc is used also in this connection. On the other hand, according to a method suggested by Ruhmer, the number of interruptions is increased by using a high-tension arc passing between metal electrodes. The latest type of generator, fed with high-tension direct current, furthermore affords the very considerable advantage of allowing the length of the explosive distance to be maintained absolutely constant for any length of time, thus making vibrations extremely regular, which in the case of arcs between carbon electrodes is not the case. The metal electrodes used in this connection are constituted by metal wires with square cross sections between the longitudinal edges of which the discharge is formed. These wires are placed upon two insulated storage rollers, from which they are unwound on two insulated rollers by a small electro motor with double worm gearing, so as to travel at moderate speed close to one another over two grooved rolls designed as cooling vessels. The electrical discharge is produced at the point of closest proximity between the wires, the length of the arc (accurately adjusted by means of a micrometer screw) being maintained constant by the continually varying portions of metal between which the discharge is made to pass. At the same time is effected an excellent cooling of the discharge which considerably increases its activity, a substantial electro-magnetical blower being used to deflect it. As the points of origin of successive discharges are always situated on the edges of the wire, any irregularity is effectually avoided.

This generator has been used with a number of tests made over considerable distances. In connection with the first experiments made in 1907 the transmitting station was located in a small shed close to the Congo Museum at Tervueren, Brussels, the high-tension direct current being supplied from a set of several 500-volt dynamos connected up in series and operated by a gasoline motor. The receiving station was situated in a cottage about fifteen kilometers distant at Uccle.

These experiments in connection with which remarkable sound intensities could be obtained were continued in the following year over greater distances, the transmitting station being transferred to the Brussels Palace of Justice, which on account of its situation and height constitutes an excellent antenna support. The high-tension direct current was supplied by a high-tension accumulator battery, and the receiving apparatus was installed successively at the Namur citadel (at fifty kilometers distance) and at the Liège Observatory, distant about 110 kilometers, a satisfactory transmission of conversation being obtained in both cases.

Another experimental station for wireless telephony has been installed at Ruhmer's Berlin laboratory. The generator there used is fed from a high-tension accumulator battery comprising 3,000 cells.

The New Rigid Dirigible of the English Navy. "N I."

By Carl Dienstbach

THE Zeppelin Airship Construction Company has always firmly refused to build any airships for foreign countries, on the ground that its plant is virtually a gift and a trust of the German nation, that contributed nearly $2,000,000 to Count Zeppelin's enterprise, and that therefore none of the experiences and facilities of the Zeppelin dockyard should inure to the benefit of foreign governments.

In England the authorities have been so severely criticised for "trifling" with the serious question of an aerial navy, and

¶ A HOME-MADE 100-MILE WIRELESS TELEGRAPH SET

Read Scientific American Supplement 1605 for a thorough, clear description, by A. Frederick Collins. Numerous adequate diagrams accompany the text. Price, 10 cents, by mail. Order from your newsdealer or *Munn & Co., Inc.*, 361 Broadway, N.Y.

merely building a series of pygmy military dirigibles for experimenting and training purposes, that the English people bought by subscription the two latest and best French airships, the big "Clement-Bayard II" and the new gigantic "Lebaudy," and presented them to the government. Patriotic and welcome though this action was, it may be said to have been inspired by a popular misunderstanding of the government's policy. For England the first necessity is a naval dirigible. An airship that must be capable of hovering over the channel fleet's field of action and follow the home fleet far out into the North Sea had not yet been developed abroad, nor could it be created over night. Endurance, staunchness, economy of fuel at high speed, insensibility to weather and sun, were the qualities most desired. The authorities were soon aware that the type perfected by Count Zeppelin and his engineers and pilots came nearest to meeting these requirements, but all endeavors to profit directly from the priceless experience and skill acquired by the Count and his staff during nearly a decade of painstaking labor met with a flat refusal. Nothing remained but to make the experiment unaided, and it must be conceded that the English have approached this task with a deliberateness and thoroughness worthy of its importance. What it really meant may be gathered from the failure of the Schütte-Lanz giant rigid dirigible, whose wooden frame cost hundreds of thousands, and finally became far too heavy. In England a colossal revolving arm or "whirling table," was erected at great expense for the sole purpose of testing the naval airship's propellers under the conditions that prevail in actual flight, and for developing the most economical type.

The English "N I," as the new aerial dreadnought is called, has just been completed after remaining on the stocks for nearly three years. From the "Zeppelins" so far built it differs first in the displacement, which exceeds even the big "Deutschland's" by fully 1,000 cubic meters, being 20,000 instead of 19,000. The length is 510 feet, instead of the "Deutschland's" 485½, and the beam 46 feet. Instead of aluminium the new lighter and stronger alloy duralumin has been used in the hull.

A noteworthy innovation is found in the engine room. Reliability of the propelling machinery of airships was for a time sought in multiplying the motor units. "Deutschland" and "Z VI," had three motors, the new "Krell I" has four motors. Most recently this tendency has undergone a temporary change. It is now the fashion to instal more powerful units, engines that are to all intents and purposes identical with those of the "big gasoliners" of the ocean, and like them are not much given to breaking down. Thus the new German military airship, "M IV," is driven by only two engines, but each of 200 horse-power, and the English "N I," built more for endurance than extreme speed over water, has also two 200 horse-power motors for its greater displacement. In the "M IV," these motors have each six cylinders and are very heavy; the engines of "N I" have eight cylinders each and are built by the firm of Wolseley of heavy gasoline traction frame. As Count Zeppelin's "Deutschland" developed a speed of nearly 38 miles an hour with three motors of 115 horse-power each, the "N I," that has finer lines at the stern, is expected to make 43 miles an hour with 55 horse-power more and only 1,000 cubic meters more displacement—which results solely from increase in length, not of beam.

In still larger airships there will be again multiplication of motor units—to distribute the load—but, each motor being of 200 horse-power, sufficient reliability will also be guaranteed in the single unit. The "N I," is equipped with powerful apparatus for wireless telegraphy.

Glycerine

MANY years ago, in an obscure mining village in Sweden, an apothecary was making lead plaster in the ordinary way by heating olive oil with litharge and water, when he chanced to notice that the liquid which was mingled with the pasty lead compound had a strangely sweet taste. On further investigation, he found that the sweet taste was caused by the presence of an oily liquid which was dissolved in the water. No such substance was described in the books of the day.

Scheele, the apothecary, knew that he had discovered a new substance. He soon found that this sweet liquid was not the product of olive oil alone, but that other oils and fats would yield it under the same treatment. So he named it the "sweet principle of fats," or "oil-sugar."

More than a century has passed since Scheele's discovery, yet it is but little over sixty years since "oil-sugar" was found to be of practical value, except for a very limited use in medicine. Chemists have given it the more formal name of glycerine, derived from a Greek word meaning sweet.

Every one to-day is familiar with the clear, thick liquid so commonly used for toilet purposes. Its soothing and softening effect on dry or inflamed skin is the quality for which it is best known in most households; but few people have any idea of the variety of purposes to which it is applied.

Among its most striking and valuable properties are its great solvent power, its chemical stability, and its sweetness. Moreover, it is digestible, will not evaporate, and owing to this and its hygroscopic qualities, will prevent the drying and hardening of materials with which it is mixed.

These peculiar qualities make it most valuable in the preparation of medicine, unguents, and various food products, as preserves and mustards; likewise in beer, wines, and other bottled goods, where it is said to act as a preservative. The fact that strong solutions of glycerine and water will not freeze in the lowest winter temperatures has caused its use in our wet "gas meters."

Some of the more important industries in which it is used are vulcanizing India rubber, silvering and gilding glass, dressing leather for gloves, preserving anatomical and botanical specimens, and the manufacture of what is, perhaps, the most powerful explosive known to science, without whose aid some of the grandest triumphs of modern engineering would have been impossible—nitroglycerine.

In a pure state glycerine is one-fourth heavier than water. After long exposure to a freezing temperature, glycerine will deposit rhombic crystals resembling those of sugar candy. Its boiling point is 490 deg. F. Pure glycerine will burn readily if first heated to about three hundred degrees. It gives a pale blue flame similar to that of alcohol, and to the chemist it is an alcohol.

There is a process by which animal fats are directly decomposed into stearic acid and glycerine, by subjecting the fat to the action of super-heated steam, at a temperature of several hundred degrees. The resulting glycerine is concentrated, and purified by steam distillation, while the steric acid, which much resembles wax, and in no way answers to our ordinary conception of acid, is in great demand for candles.

Starch in Papermaking

STARCH is commonly added to the pulp from which writing paper is made, for the purpose of rendering the paper less absorbent and preventing the ink from spreading. According to *La Nature*, the conditions of this admixture have been minutely studied by M. Traquait, who has found that the best results are obtained when the starch is added in the form of an imperfect paste, with its grains still separate, though softened by the action of hot water. In this condition the starch grains readily adhere to the fibers, stopping the pores, and aid in retaining the gypsum, talc and other fillers which are commonly added. The starch may be replaced by the mixture of the formic ethers of starch, which is sold under the name of feculose, and which may also be substituted for gelatine in the preparation of coated papers.

An International Carat

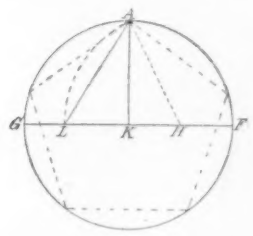
THE carat, the unit of weight for diamonds and other gems, has various values in different countries and a legal value in none. The Dutch carat, formerly 205.09 milligrams, is now 205.12 milligrams; the French, 205.9; the English, 205.409; the Arabian, 254.6, and the Bolognese, 188.5. In all, 21 different values of the carat are recognized. In consequence of this confusion, purchasers and even vendors are often deceived and only dishonest dealers are benefited.

In 1905 the International Bureau of Weights and Measures proposed the adoption of an international carat of 200 milligrams. This value became legal in France on January 1st, 1911.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12396) F. S. D. asks: I have been searching through my books and papers for a simple solution of the problem of dividing a circle into five equal parts, and cannot find it. Will you please show me through Notes and Queries? A. To inscribe a pentagon in a circle: Draw two diameters at right angles to each other. Bisect a radius as *K F* at *H*,



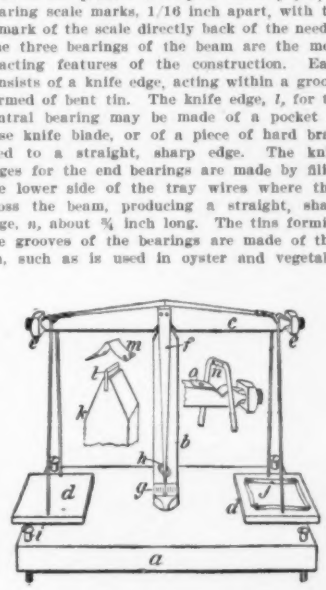
and from *H*, with a radius *H A*, describe an arc *A L*, and the chord of this arc is the side of the inscribed pentagon, which may be set off five times around the circumference as a chord. This problem is usually given in books of mechanical drawing.

(12397) W. H. W. says much discussion occurred since the explosion at Communipaw as to the effect it would have had upon an aeroplane 2,000 feet distant, at an altitude of 2,000 feet. Would it have torn the aeroplane into pieces? Was not the explosion a practical demonstration of the uselessness of an aeroplane as a destructive unit in war time? A. We would say that beyond a slight lifting of the machine for a moment, we do not believe this explosion would have had any particular effect. The air, as you know, is elastic, and it is on account of the cushioning effect that at 2,000 feet height and distance, the aeroplane would not receive a shock that would damage it.

(12398) M. S. says: While reading your issue of October 22nd last, I noticed an article on which I wish to ask you for some information. The article was headed, "The Development of the Man-Carrying, Motor-Driven Aeroplane." Now the part I am referring to is that of Mr. Maxim's aeroplane of 1892. I would like, if possible, to find out how many revolutions per minute was made with the engine described going at full speed with the 18-foot propellers? A. We have ascertained from one of the engineers who worked with Maxim that with the 14-foot propellers, the engine made 500 revolutions per minute when the aeroplane was held stationary. With the 19½-foot propellers, when running along on the rails at 70 miles per hour, the engine made 550 revolutions per minute as near as could be calculated.

(12399) P. J. S. says: Please tell me how and where I may learn how to operate a flying machine and become an aviator; and tell me on what condition a man is accepted; if he gets any salary or not. A. In reply to your inquiry as to how you may become an aviator, we will say that there are schools where men go and learn to fly. The price for a course of lessons is generally about $500. As a rule no salary is paid until one is proficient in the art of flying and is able to go out on the road and make exhibition flights. A star aviator like Hamliton has gotten as much as sixty per cent. of the gross receipts from such flying.

(12400) B. N. L. asks how to make a balance. A. A balance suitable for weighing small articles can be made easily and cheaply. Such a balance can be made sensitive to the weight of one-quarter of a postage stamp, and capable of sustaining a weight of several ounces. It is made chiefly of wood. All the parts are common articles, and only ordinary tools are required. Only certain features require careful attention; in other respects, rough work is permissible, says "School Exercises in Plant Production," by D. J. Crosby, in Farmer's Bulletin No. 408. The essential parts of a balance (see cut) are the base (*a*), the pillar (*b*), the beam (*c*), and the trays or pans, as they are usually called (*d, d*). The beam is balanced by means of the balancing nuts (*e, e*). The pointer (*f*) indicates on the scale (*g*) the effect of weights on the trays. A screw-eye (*h*) encircling the pointer serves to hold the beam at rest, or permits it to swing, as desired, according as the screw-eye is turned. Four screws (*i*) at the corners of the base serve to level the balance. In making the balance thorough dry, soft pine wood is preferable. Screws are preferable to nails. The base is 12 or 14 inches long by 7 inches wide and 1 inch thick. The pillar is 1 inch square and about 9 inches high. It can be set in an inch hole in the center of the base. Care should be taken to have it stand perpendicular to the base. The upper end of the pillar is beveled on the right and left sides, as shown at *k*. A slot is sawed in the end to receive a knife edge, as shown at *l*. The beam is made from a stick 1 inch square and about 10 inches long. Its lower face is left straight; the other faces are beveled from the center to the ends, which are left ⅜ or ½ inch square. A notch 1 inch wide and ½ inch deep is accurately cut in the center of the flat or bottom face. This receives the central bearing *m* of the beam. An inch from each end of the beam a notch ¼ inch deep is cut to receive the tray bearings. Each end is rounded to receive the balancing nuts. The nuts should cut well defined threads in the wood and move easily and smoothly. Applying a little soap to the threads helps this. A strong pointer *f* is firmly fastened to the beam by two or more screws. Its lower end is provided with a needle, colored black so as to be readily seen. The screw-eye, *h*, is placed near the end of the pointer and in the center of the pillar. It should turn easily and smoothly. When the balance is otherwise completed, turn the screw-eye so as to hold the pointer firmly, then paste to the pillar back of the pointer a strip of white paper, *g*, bearing scale marks, 1/16 inch apart, with the 0 mark of the scale directly back of the needle. The three bearings of the beam are the most exacting features of the construction. Each consists of a knife edge, acting within a groove formed of bent tin. The knife edge, *l*, for the central bearing may be made of a pocket or case knife blade, or of a piece of hard brass filed to a straight, sharp edge. The knife edges for the end bearings are made by filing the lower side of the tray wires where they cross the beam, producing a straight, sharp edge, *n*, about ¾ inch long. The tins forming the grooves of the bearings are made of thin tin, such as is used in oyster and vegetable



cans. Bright pieces are selected. The central bearing requires a strip 1 inch wide and 2 inches long, *m*. It is bent across at the middle, the bend being lightly hammered flat on a flatiron. The ends are then separated. The halves of the strip curve somewhat, leaving a narrow angle at the bend. This tin is firmly held in the central notch of the beam by four small screws. The tin strips for the end bearings are about ½ inch wide. They are bent in the same way as the other. One end of the strip is longer than the other, and is punched to receive a single screw holding it to the beam, as shown at *o*. The bending of the tin strips roughens the surface of the groove. It must be polished by rubbing the back of the point of a knife blade back and forth in the groove for some time. To insure success, the grooves must be very narrow to prevent side slipping, yet not so narrow as to bind on the knife edge. The highly polished groove and sharp knife edge produce the least friction, and increase the sensitiveness of the balance. The trays are made of common No. 12 wire. The trays are 3 by 3 inches and ¼ inch thick. Two holes near opposite edges receive the wires, which are bent in opposite directions beneath the trays, thereby holding them firm and level. If the trays tend to swing from front to back of the balance, the tins of the bearings may be slightly twisted by inserting a knife blade under them. The balance can now be tested for use. When in working condition the pointer will slowly swing back and forth many times, and finally come to rest at 0 of the scale. It probably will not do this at the first trial. Set the balancing nuts at about equal distances from the ends of the beam, then stand tacks along the lighter beam arm until the two arms nearly balance. The tacks are then driven in permanently. If tacks are too light, use brads or screws. The final balancing can then be done by properly moving one or both of the nuts. The proper adjustment of the balancing nuts should be tested each time the balance is used. Weights, and objects to be weighed, can be held on the trays by cardboard dishes, *j*. A pair of forceps can be made from a strip of spring brass, or even of hickory wood, the points being properly sharpened. A set of metric weights ranging from 20 grammes to 1 centigramme, and suitable for use with this balance, can be had for $1 or less.

Electricity

Telephone Line at Panama Canal.—The telephone line across the Isthmus of Panama, following the Panama Railroad, is being strung on poles made of old steel rails. The rails are 28 feet long, and are set in concrete bases.

New Volt Adopted by France.—The new volt, based on the standard Weston cell and recommended by the International Committee, has now been adopted by the United States, Germany and France. The change in France has only just been effected. Owing to the fact that the former volt used in France was based on the Clark cell, but the temperature of the Clark cell was not given, it was a simple matter to adopt the new value of the volt by merely specifying the temperature of the Clark cell, which would give a value equal to that assigned to the Weston cell.

Electric Lamps for Miners.—There appears to be considerable activity in Germany in the development of electric lighting outfits for miners. These consist usually of a small lamp, with a storage battery weighing from 2½ to 6 pounds, and capable of storing sufficient current to energize the lamp for from a few hours to a full day. Primarily, these lamps were designed for the use of men engaged in mine rescue work, but it is found that they can be used economically for general mine work. It is said that there are seventeen kinds of electric miners' lamps now being manufactured in Germany by eight different firms.

Rust and Electricity.—Contrary to expectations, the wires of a fence which are farthest removed from the ground are more apt to rust than those which actually run through the dew-laden grass. In an effort to explain this phenomenon, Mr. M. L. King, of the Agricultural Engineering Department of the University of Iowa, has made an investigation, disclosing the fact that a current of electricity is commonly to be found in the lower wires of fences, this current sometimes amounting to 0.001 of an ampere, with a difference of potential of one volt between the wire and the ground. No such currents can be detected in the upper wires. It is Mr. King's opinion that this current accounts for the preservation of the lower wires against rust.

Electrical Show at College.—In a recent issue of the SCIENTIFIC AMERICAN we referred to the increasing number of electrical shows and their success, also to the fact that in a number of cities they have become a permanent annual feature. We should have mentioned in this connection the annual electrical shows held by the Michigan State College at East Lansing, Michigan. In the second week of March, of this year, the third annual show will be held by the college. It will be devoted, to a large extent, to a demonstration of the use of electricity in the home. Another subject that will receive considerable prominence is that of illumination, and examples of the best methods of lighting bed rooms, dining rooms, etc., will be given. The illuminating engineer has had so much to do in solving problems of illuminating public buildings, industrial buildings and the like, that heretofore the home has not come in for as much attention as it should have received.

Towing Locomotives for the Panama Locks.—The plans have recently been completed for the locomotives which are to haul ships through the locks of the Panama Canal. These locomotives will be decidedly novel in construction. Each locomotive is to consist of three sections, a central section containing the cable drums for the tow line, and a traction section fore and aft. The central section will be connected to the end sections by means of universal joints. The locomotives will be obliged to climb from the lower to the upper level of the locks and hence are provided with a rack and pinion traction system. Horizontal wheels will also be provided, to bear against the sides of the rack so as to overcome the lateral pull of the tow line. Each traction section will be provided with a 75-horsepower motor, and current will be supplied from conductors placed in a conduit at one side of the track. The maximum pull of each locomotive will consist of 25,000 pounds, a friction clutch being employed, which will yield if the pull exceeds this maximum. Each vessel will be drawn by a number of locomotives, depending upon its tonnage, and the locomotives will do no hauling while ascending from one level to another.

Engineering

Total Work Done at Panama.—The grand total of excavation already done on the Panama Canal up to February 1 was 129,138,400 cubic yards, leaving to be excavated 53,399,366 cubic yards. Total excavation for January of this year was 2,772,170 cubic yards, as compared with 2,831,929 cubic yards in January of 1910.

Canadian Railroad Construction.—Canada has been a center of remarkable railroad activity during the past year. The Canadian Northern led with the construction of 484 miles of road. The National Trans-Continental built 437 miles; the Canadian Pacific 367 miles, and the Grand Trunk Pacific 335 miles. In addition to this, 3,101 miles are in course of construction.

Record Trans-continental Trip.—A special train has recently made the trans-continental trip from Yuma to New York, covering a distance of 3,100 miles, in 80 hours, at an average speed of 38¼ miles an hour. The journey from Chicago to New York, 975 miles, was made in 1,000 minutes. The total cost of this special train, which was run for a medical consultation, is stated to have been $7,100.

Endurance of Structural Timber.—Some experiments of Mr. C. P. Buchanan on bridge timbers which have seen 25 years of service seem to prove that there is no necessary deterioration of structural timber which has been properly protected. The tests which he made show that bridge timbers which had been a quarter of a century in service were stronger than selected pieces of timber a year old, which had been passed as first class building material.

We Build Warships Rapidly.—To-day, warships are built in the United States in not much more than half the time required ten or fifteen years ago. Chief Constructor Watt attributes this increase in rapidity to greater familiarity with government work on the part of contractors, to the provision of more complete plans by the Navy Department, and to the effort to restrict changes in contract plans as much as possible. Ton for ton, we build as quickly as the foreign navies and actually for less cost.

A New French Submarine.—The latest French submarine is provided with an engine which is used both on the surface and in the submerged condition. This result is secured by a special system, in which the heat is stored up and subsequently utilized when the vessel is beneath the surface. The French claim that the trials which have already taken place show that this vessel is capable of an under-water speed much greater than can be obtained by means of the accumulators which are used on other submarines.

British Dreadnought "King George V."—Hitherto British dreadnoughts have been of smaller displacement than those of some other navies. The latest to be laid down, however, the "King George V," is well to the front, with a total displacement of 25,000 tons normal. She is 570 feet long, 88¾ feet beam, and 27¾ feet mean draft. The turbines of 31,000-horsepower give her a speed of 21 knots. She will carry ten 13.5-inch guns in five turrets, all on the center line, together with a torpedo defense armament of twenty-four 4-inch guns.

The First Oil-driven Ocean Vessel.—The credit for building the first ocean-going vessel fitted with reversible Diesel engines should be given to the Dutch. This vessel, the "Vulcanus," built by the Netherlands Shipbuilding Co., Amsterdam, for the Anglo-Saxon Petroleum Company, is 196 feet long by 37 feet beam, and she can carry 1,000 tons of benzine in bulk at a speed of 8½ miles per hour. The motive power consists of a 4-cycle Diesel engine, with six 16-inch cylinders, using crude Tarakan oil. The consumption is 2½ tons of oil per day of 24 hours at full speed.

Strength of Materials in Columns.—Mr. J. E. Howard, of the Bureau of Standards, gives the following comparative compressive strengths of materials per square inch when used in piers or columns: Steel and cast iron, each 30,000 pounds per square inch; hard brick piers laid in cement mortar, 4,700 pounds, laid in lime mortar, 1,000 pounds; mortar, 1 to 1, 5,000 pounds, 1 to 3, 2,700 pounds, 1 to 5, 1,100 pounds; long leaf pine, from 4,500 to 7,000 pounds per square inch; short leaf pine and spruce, 3,000 pounds, and Douglas fir, 4,000 pounds per square inch. It should be noted that 7,000 pounds is an unusually high result for long leaf pine.

Aeronautics

A Safety Parachute for Aviators.—M. Hervieu has just brought out a new parachute that folds in a small space behind the aviator and that, in case the aeroplane capsizes or plunges to earth, quickly opens and jerks him out of his machine, no matter in what position it may be. A dummy weighing 150 pounds and seated in a Blériot monoplane body was recently launched off the Eiffel Tower when equipped with one of these parachutes. Both figure and aeroplane settled gently to the ground. The demonstration was apparently successful.

New Aeroplanes for the English Army.—Two Short-Farman biplanes have recently been handed over to the aerial authorities of the British government by the Royal Aero Club for the use of naval officers' training in aviation. The army has also acquired a Paulhan biplane, which successfully underwent its acceptance tests on January 11th, at Buc, flying for two hours with a passenger and 440 pounds of ballast in a 25-mile wind and gliding to earth with the engine stopped from a height of 650 feet. The machine was undamaged.

A New Monoplane Speed Record.—A new speed record over a circular course of the exceptionally small circumference of 2.5 kilometers (1.55 miles) was made on the 13th ultimo by Busson. This aviator beat all records up to 40 kilometers, but was obliged to descend after completing 48 owing to fog. He drove his Deperdussin monoplane at the rate of 58.83 miles an hour, thus beating Louis Breguet's military biplane record of 29:40 for 40 kilometers (24.84 miles) by 4 minutes 9 1/5 seconds. His average speed was 5.2 miles an hour faster than Breguet's, despite the fact that he flew over a much smaller circular course.

Recent Fatalities in Germany and France.—On the 6th ultimo Lieut. Stein, of the German army, fell to his death in his Farman biplane at the Doeberitz aerodrome. He was descending at a sharp angle from a height of some 300 feet. When within 50 feet of the ground he apparently turned his machine too sharply, the result being that he was thrown out of the biplane and fell to the ground, breaking his back and dying instantly. His was one of the few cases in which an aviator has been thrown out of his machine. A double fatality occurred in France three days later in somewhat the same way. Jules Noël was piloting a Sommer biplane with La Torre as passenger. After making a beautiful flight of an hour's duration, he throttled down his motor and made a sharp glide to earth from a height of 400 or 500 feet. M. Sommer made a snapshot of him when 300 feet from the ground. Just after this the machine dove sharply and struck the ground with terrific force. Noël had been warned the day before not to glide down at so sharp an angle, and it was failure to heed this warning that cost him and La Torre their lives. Even with front and rear horizontal rudders some machines cannot be righted when they are directed earthward at too sharp an angle and the center of pressure moves far to the rear of the planes.

The Crew of the "Suchard."—The pilot of the "Suchard" is Captain Joerdens, of the German army, a licensed pilot of spherical balloons, who took part, though not as pilot, in the thirteen hours' flight in a dark stormy night across the North Sea, from Munich to the Orkney Islands, in the balloon "Touring Club." During this thirteen hours between sky and water the three balloonists did not know their whereabouts, and lost one of their number, who dropped out when the car was once struck by a huge wave in the darkness. As Capt. Joerdens went safely through such an ordeal, he is looked upon as "mascot" of the "Suchard." He is now receiving instruction in the piloting of dirigible balloons with the Parseval Company, and will make at least twelve trips under the guidance and instruction of Lieut. Stelling, the best Parseval pilot, before he will become the captain of the "Suchard." The navigator of the "Suchard" is Capt. Friedlaender, retired, of the German navy. Murray Simon, the navigator of Wellman's "America," has also offered his services to the Brucker expedition. The chief engineer to look after the engines is Mr. Mueller-Peissenberg, a very experienced man. Dr. E. Alt, of the Royal Bavarian Meteorological Central Station in Munich, is on the "Suchard" as meteorological and aeronautical observer. Mr. August Luechow, of New York city, has offered Herr Joseph Brucker a prize of $2,500 in case he reaches America in his trip from the Cape Verde Islands.

Science

A Meteorological Station in the Antarctic.—There are persistent rumors that the Australian government is planning to establish a meteorological station on the coast of the Antarctic continent, to be connected by wireless with Australia and New Zealand.

Black Snow.—A case of "black" snow that occurred recently in the lower Emmen Valley, Switzerland, is described in *Nature*. The snow was not black when it fell, but was followed by a fine rain, and then by a freeze. A crust of pure ice was thus formed, beneath which was a small air-filled space, and the light when reflected from the snow beneath produced to the eye a dark appearance.

Further Exploration by Shackleton.—Sir Ernest Shackleton is to head an expedition to Spitzbergen during the coming spring. The party will number six, including some members of the "Nimrod" expedition, and will undertake biological and geological researches. Shackleton is planning to organize later an expedition on a large scale to the Antarctic. The program includes a general circumnavigation of the Antarctic continent, and it is proposed to land three parties, of nine men each, at Cape Adair, Sabrina Land, and Enderby Land, each with complete stores for two years. These parties are to work inland over the great ice cap.

Apparatus for Measuring Snowfall.—The United States Weather Bureau has just published a new and enlarged edition of the pamphlet entitled "Measurement of Precipitation." This edition, as compared with its predecessors, is notable for containing full information concerning the methods and apparatus recently introduced (in part, experimentally) by the bureau for measuring snowfall, with pictures of several devices due to Prof. Marvin and others. The problem of correctly measuring the heavy snowfall of mountain regions has an important bearing on irrigation problems, and is being actively studied, not only in America, by the Weather Bureau, but also in the Alps, by the official meteorologists of Switzerland.

Halley's Comet and Atmospheric Dust.—Dr. John Aitken, inventor of the dust counter, and tireless investigator therewith, made a series of observations on the dustiness and haziness of the atmosphere in the Scottish Highlands for several days about the time of the passage of Halley's comet, the results of which have just been published. The atmosphere was found to be abnormally dusty during the presence of anticyclonic conditions, and Dr. Aitken suggests that this may have been due to the downward movement of the air under such conditions bringing down dust from the upper atmosphere. That the unusual dustiness of the upper atmosphere thus indicated may have been due to the comet is a natural inference, but, as in all the other investigations of this disappointing comet's effect upon the atmosphere, the verdict must be "Not proven."

The Meteorological Service of Madagascar.—In a lecture before the Meteorological Society of Mauritius, Father Colin, S. J., the veteran director of the observatory of Tananarivo, recently described the excellent meteorological service that he has organized in Madagascar. Besides the well-equipped central observatory, there are twenty-five stations, eleven of which are spread along the eastern coast, seven in the interor, and seven on the western coast. These stations make tri-daily observations of the barometer, psychrometer, maximum and minimum thermometer, rain gage, direction and force of the wind, cloudiness, and (at coast stations) the state of the sea. The midday observations are telegraphed to the central observatory, which is thus enabled to maintain a storm-warning service. It is hoped to extend the field of observation by cable reports from Réunion and Mauritius. It is pertinent to call attention to the extraordinary activity of the Jesuits all over the world in the field of science that embraces meteorology, terrestrial magnetism, and seismology. The official weather service of the Philippines, and the quasi-official weather service of China are both entirely in the hands of this order, while Belén College Observatory, at Havana, the Haynald Observatory, at Kalocsa, Hungary, and the new observatory of the Ebro, in Spain, may be mentioned as among the more important units in the world-wide *réseau* of meteorological and geophysical stations maintained by the same body.